modern castings

MAY 1957
AFS ENGINEERED CASTINGS ISSUE

1st ENGINEERED CASTINGS SHOW
61st AFS CASTINGS CONGRESS

future meetings and exhibits

MAY

Apr. 29-May 1 . . Association of Iron & Steel Engineers, *Spring Conference.* Terrace Hilton Hotel, Cincinnati.

29-May 3 . . American Material Handling Society, *7th National Materials Handling Conference.* Convention Hall, Philadelphia.

30-May 2 . . Investment Casting Institute, *Annual Spring Meeting.* Park Sheraton Hotel, Washington, D. C.

5-9 . . American Ceramic Society, *Annual Meeting.* Statler Hilton Hotel, Dallas, Texas.

6-10 . . American Foundrymen's Society. *The 1st Engineered Castings Show,* and *The 61st Castings Congress,* Netherland-Hilton Hotel, and Music Hall, Cincinnati.

8-9 . . Non-Ferrous Founders' Society, *Annual Meeting.* Netherland-Hilton Hotel, Cincinnati.

15-17 . . National Industrial Sand Association, *Annual Meeting.* The Homestead, Hot Springs, Va.

19-22 . . Industrial Heating Equipment Association, *Spring Meeting.* The Homestead, Hot Springs, Va.

22-23 . . American Iron & Steel Institute, *65th General Meeting.* Waldorf-Astoria Hotel, New York.

JUNE

2-6 . . Air Pollution Control Association, *Golden Jubilee Meeting.* Jefferson Hotel, St. Louis.

3-4 . . AFS Technical Council, Chicago.

3-5 . . American Management Association, *General Management Conference.* Hotel Statler, New York.

5 . . AFS Publications Committee, Chicago.

10-11 . . Magnesium Association, *Annual Meeting.* The Homestead, Hot Springs, Va.

13-14 . . AFS *14th Annual Chapter Officers Conference.* Sherman Hotel, Chicago.

13-14 . . Malleable Founders' Society, *Annual Meeting.* The Broadmoor, Colorado Springs, Colo.

16-21 . . American Society for Testing Materials, *Annual Meeting.* Chalfonte-Haddon Hall, Atlantic City, N. J.

16-29 . . American Material Handling Society, *Fourth Annual Material Handling Training Conference.* Lake Placid Club, Essex County, N.Y.

17-21 . . American Society for Engineering Education, *Annual Meeting.* Cornell University, Ithaca, N. Y.

20-22 . . AFS *2nd Annual Foundry Instructors' Seminar,* Kellog Center, Mich-

igan State University, East Lansing, Mich.

20-22 . . *Penn State Regional Foundry Conference.* Penn State University, University Park, Pa.

23-25 . . Alloy Casting Institute, *Annual Meeting.* The Homestead, Hot Springs, Va.

27-28 . . Refractories Institute, *Annual meeting.* The Greenbrier, White Sulphur Springs, W. Va.

AUGUST

19-24 . . 24*th International Foundry Congress,* Arranged by Swedish Foundrymen's Association. Parliament Bldg., Stockholm, Sweden.

SEPTEMBER

17-20 . . American Die Casting Institute, *Annual Meeting.* Edgewater Beach Hotel, Chicago.

23-24 . . Steel Founders' Society of America, *Fall Meeting.* The Homestead, Hot Springs, Va.

27-28 . . AFS *Missouri Valley Regional Conference.* Missouri School of Mines and Metallurgy, Rolla, Mo.

OCTOBER

2-3 . . AFS *Michigan Regional Foundry Conference.* Kellogg Center, East Lansing, Mich.

9-11 . . Gray Iron Founders' Society, *Annual Meeting.* Drake Hotel, Chicago.

17-19 . . Foundry Equipment Manufacturers Association, *Annual Meeting.* The Greenbrier, White Sulphur Springs, W. Va.

18-19 . . AFS *New England Regional Foundry Conference.* Massachusetts Institute of Technology, Cambridge, Mass.

18-19 . . AFS *Northwest Regional Foundry Conference.* Hotel Vancouver, Vancouver, B.C.

21-25 . . National Safety Council . . 45*th National Safety Congress and Exposition.* Conrad Hilton Hotel, Chicago.

24-25 . . AFS *Niagara Frontier Regional Foundry Conference.* Statler Hotel, Buffalo, N. Y.

31-Nov. 1 . . 10*th Annual Purdue Metals Casting Conference.* Purdue University, Lafayette, Ind.

NOVEMBER

3-8 . . American Society for Metals and Society for Non-Destructive Testing . . 2*nd World Metallurgical Congress* & 39*th Annual National Metal Congress.* Morrison Hotel, Chicago.

7-8 . . National Foundry Association, *Annual Meeting.* Waldorf-Astoria Hotel, New York.

11-13 . . Steel Founders' Society of America, *Twelfth Technical and Operating Conference.* Carter Hotel, Cleveland.

German Cupola Operates on Blast Furnace Principle

A basic-operated, carbon-lined, hot blast cupola has been designed in Germany to supply molten metal for open hearth furnaces in steel mills. It is claimed to be the fastest means for increasing steel ingot production and reducing costs.

The design principles used in the system more closely approach those in blast furnace practice than those in the cold blast cupola.

Fumes and dust emitted from the stack of a cold blast cupola are completely absent in the new design. All cupola gas is withdrawn from the cupola several feet below the level of the charge which is maintained fairly uniform through stock line recorders. The cupola gas is cleaned and delivered under pressure for plant use. Fifty-five per cent of the cupola gas is used for heating the blast. Blast temperatures of 1100 to 1200 F are continuously and uniformly maintained.

The carbon lining in the hearth lasts indefinitely, with patching around the tuyeres every six to eight weeks. This is in contrast to shutting down every 72 to 80 hours for relining a cold blast acid cupola.

This cupola will operate on a 100 per cent charge of the cheapest grades of steel scrap, using furnace coke. Cast iron scrap and foundry coke are not required, nor is desulphurizing.

The effect of cupola metal upon open hearth production rates and costs has been definitely determined over a period of three years of operation in German plants. These results definitely establish the basic-operated, carbon-lined, hot blast cupola as the most expeditious means for increasing ingot production and reducing ingot costs.

Another use for the basic-operated, carbon-lined hot blast cupola is supplying hot metal to oxygen blown converter plants. This combination affords just about the cheapest cost in terms of production.

Considerable research in the hot blast system has been conducted in Europe and England. In the December issue of Modern Castings, William Y. Buchanan, John Lang & Sons Ltd., Johnstone, Scotland, discussed the warm blast cupola, a modification of the hot blast system.

This material is an abstract of a paper entitled "Basic Hot Blast Cupola as Source of Hot Metal for Steel Plants" which was presented at the 1956 A.I.S.E. convention and Iron and Steel Exposition by E. S. Harman, president, E. S. Harman Corp., Chicago, and Siegfred Tunder, technical director, Gesellschaft fur Huttenwerksanlagen, Dusseldorf, Germany.

◀ CIRCLE NO. 123, PAGE 7-8

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modern castings

in this issue

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AUDITED PAID CIRCULATION ABC

On The Management Side

■ **1500 Design Engineers Can't be Wrong!** This representative group of design engineers has expressed its opinions in a broad survey made by R. C. Meloy, marketing director, Gray Iron Founders' Society. These 1500 design engineers indicated that they would welcome assistance from foundrymen in:

1. Designing products to take advantage of castings.
2. Designing castings for economical manufacture.
3. Gaining general information on gray iron properties.

Asked to indicate the most important characteristics of gray iron they listed the following, in order of importance —low cost, ability to cast in complex shapes, machinability, wear resistance, resistance to distortion, appearance, vibration absorption, corrosion resistance, tensile strength, compressive strength, close dimensional tolerance, heat resistance, and low notch sensitivity.

Foundrymen's sights should be set on the gray iron characteristics engineers would like to see improved. In order of importance, improvements are desired in strength, soundness, dimensional tolerance, quality consistency, machinability, ductility and several other properties.

Being aware of customers' casting requirements and meeting these needs through improved foundry technology should keep our foundry industry competitive with all other metal forming processes.

■ **Chapel in the Pines.** Does your company employ a chaplain to help employees with domestic and personal problems? The E. B. Germany Works of the Lone Star Steel Co., Lone Star, Texas, has for a number of years employed a full time chaplain to render assistance in the personal problems of its 3600 employees. Lone Star Steel feels that employees, unhappy because of personal problems have an adverse affect on fellow workers and production. Need for this help is demonstrated by the fact that as manv as 25 to 50 employees visit the chaplain daily in his office.

As a result of efforts of company president E. B. Germany, this program was recently enlarged by building a chapel for the use of employees at all times. Nestled in a group of tall pine trees this interdenominational project has been appropriately named "Chapel in the Pines." The chapel is equipped with an electric organ which is played and heard over the plant area during each shift change.

■ **You Are Safer at Work.** Yes, thanks to industrial management efforts to make their plants a safe place to work, you are less apt to have an accident while at work than when away from the job. According to F. W. Braun, vice-president in charge of accident prevention for Employers Mutuals of Wausau, Wis., of 95,000 persons killed accidently in 1956 only 14,300 died in industrial mishaps. Furthermore, you're safer working with a machine than with your fellow human beings in industry. Unsafe machinery accounted for only 15 per cent of all U.S. industrial accidents while "human failure" caused all the rest.

Through the editorial content of its pages, Modern Castings has been doing its bit toward making the castings industry safety-conscious. This effort has recently been recognized by the National Safety Council in voting Modern Castings the National Safety Council's Public Interest Award for 1956. A similar award was also received in 1955.

Remember—*it is better to be careful a thousand times than to be killed once!*

X-Ray Process Eliminates Dark Room, Speeds Service

A new rapid, economical method for inspecting castings has been announced by General Electric Co.'s x-ray department in Milwaukee.

Known as xeroradiography this process has the advantages of requiring no dark room for developing films, being able to erase the image from the plate and to reuse plates an indefinite number of times, requiring only 20 to 45 seconds elapse between exposure to x-rays and viewing the image.

Exposure to viewing time cut to 20 to 40 sec and produces a 3-dimensional appearance.

The advantage of xeroradiography lies in the fact that a salenium-coated metal plate can be electrostatically charged. X-rays are then passed through the casting and strike the plate, partially discharging it in inverse proportion to the density of the x-rayed object. The plate is dusted with a powder which adheres to the charged parts of the plate (like iron filings to a magnet), gathering more closely in the higher charged areas, thus forming a visible image. The image produced has a three-dimensional appearance and is within the popular two per cent sensitivity required for conventional industrial x-ray films.

It's easy to obtain product data with the postage-free Reader Service Cards provided on pages 7-8. Use them for information on advertised products, too. Just circle the key number appearing at bottom of the ad.

Technical Courses Attract 225 to Quad City Program

■ Quad City Chapter's six-week series of technical sessions on foundry fundamentals was concluded April 4 with 225 attending the courses held at United Township High School, East Moline, Ill.

The program opened in February with W. O. McFatridge, International Harvester Co., Chicago, speaking on *"Foundry Foundamentals."*

Patterns and core boxes were discussed at the second meeting. Participating were Harold Rasmussen, General Pattern Corp.; Gale Meyers, Farmall Works, International Harvester Co.; and Medie Hakeman, John Deere Malleable Works.

Two speakers outlined coremaking problems and techniques at the third course. Shell, oil and CO_2 cores were analyzed by John Stock, John Deere Waterloo Tractor Works; and John Smillie, Deere & Co.

Fundamentals of molding were featured at the March 21 session. Subjects discussed were *"Squeezer and Stack Molding"* by Medie Hakeman; *"Mold Blowing, Cope and Drag, and Slinger,"* Robert Roth, Farmall Works, International Harvester Co.; and *"Shell Molding,"* T. L. Burkland, Deere & Co.

Three phases of melting operations were covered at the fifth meeting. Mervin Horton, Deere & Co., spoke on cupola melting; Marshall Petty, Black Products, outlined problems of electric melting; and Eric Welander, John Deere Malleable Works, handled duplexing operations.

The final meeting, April 4, centered around casting design. Arthur Scharf, Battelle Memorial Institute, Columbus, Ohio, was the speaker.

Lyle Brogley, Farmall Works, International Harvester Co., chapter chairman; Mervin H. Horton, chapter vice-chairman; and John Smillie, chapter secretary-treasurer, served as moderators. Other moderators were Medie Hakeman and Eric Welander.

Well, I thought Sandy was a better name than malleable.

products and processes

CO_2 sand mixer eliminates heating of sand by means of flexible, spring-steel arms to move sand against mixer walls where it is rubbed and squeezed. Action said not to heat or crush the sand. Used in making internal cores for semi-permanent mold castings. Consistent sand mixes reported. Mixer occupies little floor space, can be moved by fork lift truck and requires no foundation. Discharge door, 28 in. above the floor, accommodates 3 cu ft wheelborrow. Operated by 5 hp motor with overload protection, directly connected to gear reduction unit. *Federal Foundry Supply Co.*

CIRCLE NO. 1, PAGE 7-8

Core additive is vehicle added to graphite or talc and applied to cores or molds by dipping or spraying. Said to build-up insulating medium between metal and core and give smooth surface preventing metal penetration. When mixed heavily with refractories it smooths out irregularities. *United Oil Mfg. Co.*

CIRCLE NO. 2, PAGE 7-8

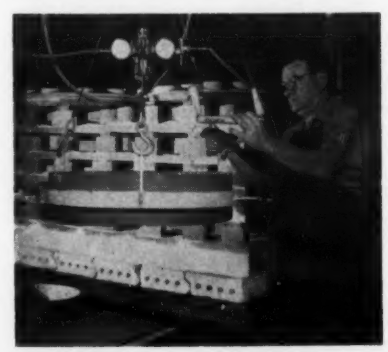
Dust collector uses centrifugal force to precipitate particles into 55-gal drums. Automatic air-tight sealing feature on drum eliminates need for clamps. Drums can be changed in 30 sec. Powered by 5 hp, 3450-rpm motor, collector pulls 2000 cfm of air per min through 8-in. inlet. Four legged frame provides ample clearance for drums. *Torit Mfg. Co.*

CIRCLE NO. 3, PAGE 7-8

Pattern mill for patternshops. Used on wood, plaster and non-ferrous metals. Has spindle speeds of 1000-6000 rpm. Performs recessing, machining outside or inside edges of straight or curved work, chamfering, half-lapping, and panel raising. Table has 30-in. longitudinal traverse and 18-in. transverse by handwheel and screw. Rotating auxiliary table can be fitted for circular jobs up to 24-in. diameter. *Freeman Supply Co.*

CIRCLE NO. 4, PAGE 7-8

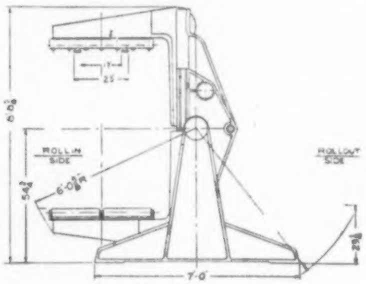
Pneumatic, rubber expansion tire is incorporated into pick-up frame for moving foundry cores or fragile objects. Unit made in various shapes consists of steel lifting frame, expansion tire and air conduit. Assembly is hung from hoist by wire rope sling. Objects lifted and moved by positioning device and inflating tire which grips firmly but without damage. *Presray Corp. Div., Pawling Rubber Corp.*



CIRCLE NO. 5, PAGE 7-8

Rollover draw machine, floor-mounted has 5000-lb capacity and handles

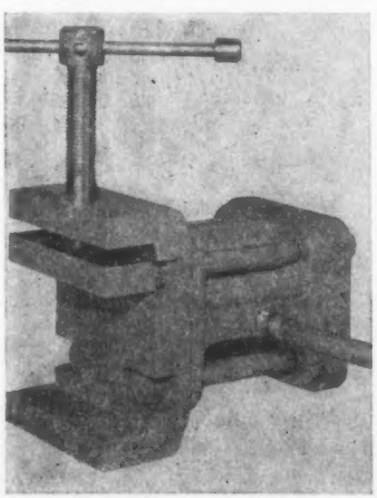
patterns requiring 24-in. draw. Accommodates flask width to 60 in. and unlimited length. Completely installed above floor level. Roll-in and roll-out heights are at normal conveyor levels. Machine may be used with large multiple-station molding or coremak-



ing units. Several pattern and core box clamping systems are available. Both roll-in or roll-out can be made at either 90 or 180 deg of axis of rollover. Single control lever actuates the completely automatic clamping, equalizing, rollover and drawing cycle. Automatic flask or core box height adjustment and automatic flask or core box equalization are featured. *Beardsley & Piper Div., Pettibone Mulliken Corp.*

CIRCLE NO. 6, PAGE 7-8

Vibrator, air powered, portable, fits any size core box. Said to save time in removing core without damaging box or distorting core. Vise-type jaw



opens to 5-½ in. for easy and secure attachment. *Cleveland Vibrator Co.*

CIRCLE NO. 7, PAGE 7-8

Shell molding sand available in four grades has high silica content for maximum refractoriness. Said to contain minimum of clay, alkali, metallic

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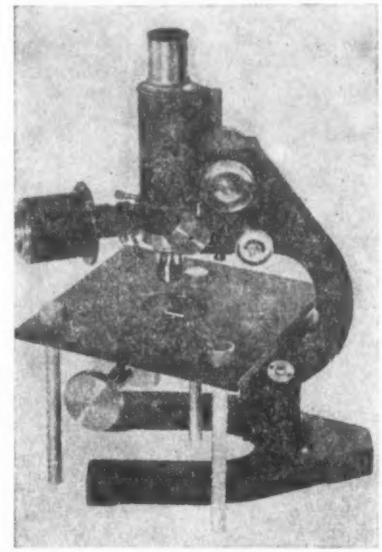
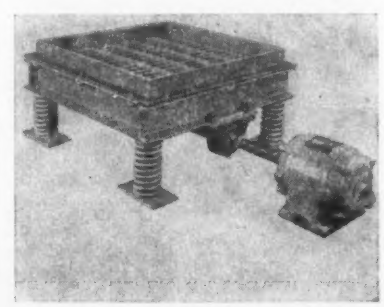
oxides and organic materials. *Pennsylvania Glass Sand Corp.*
CIRCLE NO. 8, PAGE 7-8

Strain viewer for microscopic examination of metals and solids under stress consists of specimen table with a knife-edge loading device for the



transverse loading of a miniature polished bar. Plastic strain and mode of fracture can be viewed at all conventional magnifications including 1000 diameters. When used with microscope, viewer makes it possible to view and photograph fracture initiation, propagation, slip, twinning and phase transformations resulting from stress. *Harry W. Dietert Co.*
CIRCLE NO. 9, PAGE 7-8

Foundry shakeout handles molds up to 30 in. square and weights to 500 lb. Load and shakeout are supported on soft coil springs for handling fragile castings. Unit is 13 in. high. Driv-

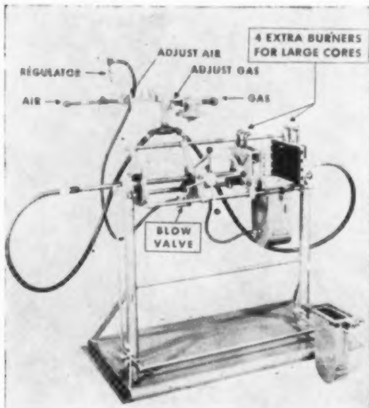


en by ⅛ hp motor with direct drive coupling. Requires no special foundation supports. *Hewitt-Robins, Inc.*
CIRCLE NO. 10, PAGE 7-8

CO_2 regulator designed for cylinder or manifold use. Delivers pressure up

to 200 psi. Operates on two-stage principle for better pressure control. *Linde Air Products Co., Div., Union Carbide & Carbon Corp.*
CIRCLE NO. 11, PAGE 7-8

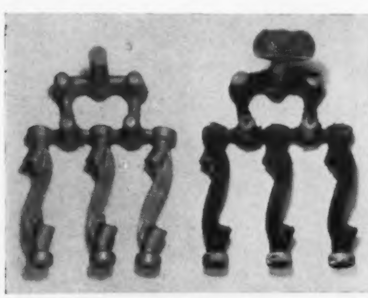
Shell core machine features direct heat application to core box, a simple clamping method and flexibility



in making core sizes and shapes. *Frederic B. Stevens Inc.*
CIRCLE NO. 12, PAGE 7-8

Hydraulic valve, semi-automatic, 4-way design, is said to provide leak-free operation with water, glycol or oil base hydraulic fluids. Rated at 3000 psi, the valve is made of corrosion-resistant materials and recommended for die casting equipment. *Sinclair-Collins Valve Co.*
CIRCLE NO. 13, PAGE 7-8

Blast cleaning at Indiana non-ferrous foundry provides high lustre using cast steel grit. Said to provide improved finish at lower cost. Weekly cleaning load consists of 35 tons of



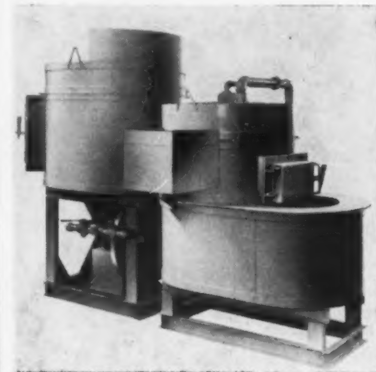
poured brass plus 2 tons given second cleaning for extra fine finish. Majority of castings weigh under 1 lb. Two airless abrasive blast machines used. *Wheelabrator Corp.*
CIRCLE NO. 14, PAGE 7-8

Synthetic wax lubricant for shell molds employing phenolic resin sand mixes, eliminates need for silicone emulsion lubricants on pattern and

CIRCLE NO. 127, PAGE 7-8

increases strength of green molds. *Nopco Chemical Co.*
CIRCLE NO. 15, PAGE 7-8

Breakdown and holding furnaces for aluminum may be used in combination or as individual components. Each unit is separate but interchangeable. Melting rates range from 450-



1600 lb. hourly; holding capacities vary from 680-2450 lb. Removing furnace top exposes entire interior for faster maintenance and relining. *Stroman Furnace & Engineering Co.*
CIRCLE NO. 16, PAGE 7-8

Circular blade saw with carbide teeth designed for cutting risers on nonferrous castings. Tips are of alternate design providing five cutting edges in every set of two teeth. *Victory Carbide Saw & Tool Co.*
CIRCLE NO. 17, PAGE 7-8

Foundry jacket fits four mold sizes. Has adjustable self-aligning slip feature. Units are drilled and various

sizes obtained by moving studs. Additional holes may be drilled for other sizes. *Products Engineering Co.*
CIRCLE NO. 18, PAGE 7-8

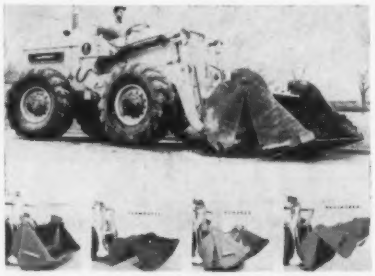
Wirebound boxes, hexagonal-shaped, weigh 44 lb. but carry more than

◀ CIRCLE NO. 128, PAGE 7-8

400-lb. load. Shape permits four boxes to be placed on skid compared to two rectangular boxes. Used by Indianapolis foundry to pack V-8 crankshaft assemblies. *Wirebound Box Manufacturers Assoc.*

CIRCLE NO. 19, PAGE 7-8

Front-end loader offers "4-in-1" bucket as optional equipment. Attachment



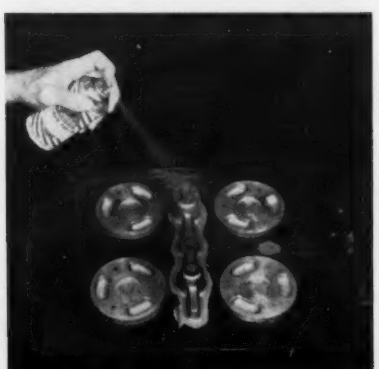
can be used as shovel, clamshell, scraper, and bulldozer. *Frank G. Hough Co.*

CIRCLE NO. 20, PAGE 7-8

Vacuum cleaner, portable, 32 in. wide, has 9 dust bags with 30 sq ft of effective cloth area. Developed for extended use over uneven floors; powered by 5 hp motor with v-belt exhauster. Dust container has 4.4 cu ft capacity. Machine handles 75-ft hose length or two 50-ft sections. *Air Appliance Div., U. S. Hoffman Machinery Co.*

CIRCLE NO. 21, PAGE 7-8

Liquid parting available in aerosol containers for coating match plates or patterns. One coating lasts from 20 to 60 molds. Designed for use on



small and medium sized jobs where air hose and gun can be eliminated. *Frederic B. Stevens, Inc.*

CIRCLE NO. 22, PAGE 7-8

Machine mounting pad reduces machinery noise and vibration. Made of resin, sisal and cork fused into integrated pad which recovers 99 per

cent of original thickness after loadings up to 1000 psi. Resists oil, water, grease and most acids and alkalis. No cementing or bolting needed for installation. *B. F. Goodrich Chemical Co.*

CIRCLE NO. 23, PAGE 7-8

Multi-pointer instruments for measuring over-fire draft, outlet draft, first and last passes and wind-box pressures are designed to be read from any location without parallax. Gages give accurate and continuous picture of air flow through boilers. Available in 2-pointer or 3-pointer models which may be combined for multiple installations. *Cleveland Fuel Equipment Co.*

CIRCLE NO. 24, PAGE 7-8

Ultrasonic transducer features water-jacketed coupling slug. Designed for high temperature degassing of molten metal, grain refinement and alloy dispersing of metal castings and chemical processing. *Acoustica Associates Inc.*

CIRCLE NO. 25, PAGE 7-8

Brass strainer for fine straining of air or gases has removable element which strains out particles 0.004 in. (90 microns) and larger. Suitable for pressures up to 500 psi. Available in pipe sizes of ¼, ⅜ and ½ in. *Watts Regulator Co.*

CIRCLE NO. 26, PAGE 7-8

Air-circuit safety device features a non-tie-down special purpose valve, a single stroke valve, and a three-way poppet palm button valve. Designed for increased operator safety, two-handed operation is required to cause a machine cycle. Only one stroke occurs regardless how long palm button valves are held down. *Ross Operating Valve Co.*

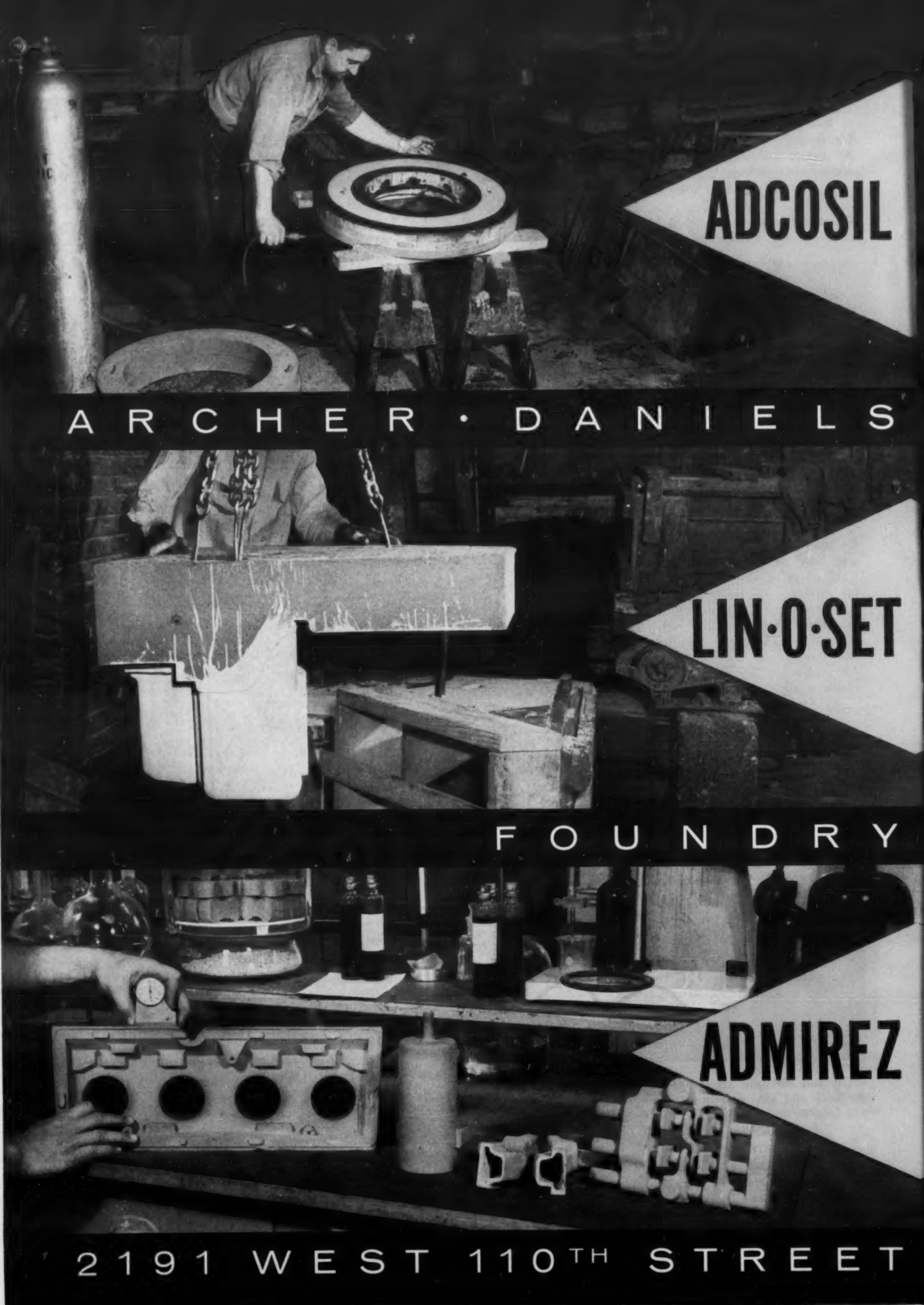
CIRCLE NO. 27, PAGE 7-8

Lubrication fitting, relief-type, attaches to bearing housings of motors, machines or pillow blocks. Features flip-open cap and internally flared body to speed discharge of excess grease. Fitting saves time and prevents over-lubrication of ball and roller bearings. *Keystone Lubricating Co.*

CIRCLE NO. 28, PAGE 7-8

Torch for removing defects in castings, cutting-off risers and cleaning castings, combines DC welding machine and compressed air for cutting, gouging or beveling any metal. Melting is done with electric arc and blown away by continuous jet of compressed air. Arc is maintained between work and a carbon-graphite

CIRCLE NO. 130, PAGE 7-8



electrode, held in torch which directs air and controls its flow. Torch may be used in any position. Air jet is continuously aligned. *Arcair Co.*

CIRCLE NO. 29, PAGE 7-8

Dust collector, may be installed in horizontal, vertical or slanting position. Filter surface consists of cone-shaped louvered steel sheet. As air passes over surface at high velocity, louvers set up forces causing small dust particles to move away from face of cone. Cleaned air, which is close to cone, escapes through louvers. Dust is carried to tapered end of cone and drawn into a secondary circuit. Concentrated dust is separated in secondary cyclonic collector and residual air returned to inlet of cone. The residual air again passes through same process. *Research Cottrell, Inc.*

CIRCLE NO. 30, PAGE 7-8

Fork truck, weighs 1000 lb, lifts its own weight. Light enough for use on old floors; will climb 20 per cent grade with 1000 lb. load. Unit is 31-½ in. wide and with mast tilted back, will clear 6-¾-ft door. *Prime-Mover Co.*

CIRCLE NO. 31, PAGE 7-8

Polyethylene mold release in aerosol container designed for casting with epoxy, phenolic or polyester resins. Product consists of solution of low-molecular weight polythylene in a mixed solvent system. Release is inert and offers no finishing or casting difficulties. *Barrett Div., Allied Chemical & Dye Corp.*

CIRCLE NO. 32, PAGE 7-8

Drum agitator for mixing in 55-gal drum is inserted in threaded bung. Unit consists of electric motor, mixing shaft and two mixing paddles said to give homogeneous mixing. Equipped with explosion-proof motor for flammable liquid mixtures. *Prenco Products, Inc.*

CIRCLE NO. 33, PAGE 7-8

Magnetic particle inspection of metal said to be improved through new material giving better definition of flaw. Also non-inflammable and odorless. One part mixed with 17 parts water is recommended. *Harry Miller Corp.*

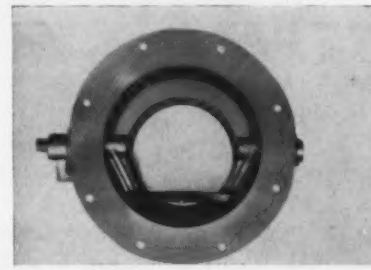
CIRCLE NO. 34, PAGE 7-8

Industrial tractor uses high-torque drive principle eliminating clutches, torque converters and mechanical or fluid transmission. Designed for general tractor application, it has draw-

bar pull of 600 lb. normal, 2000 lb. ultimate. *Automatic Transportation Co.*

CIRCLE NO. 35, PAGE 7-8

Valve for dry materials designed for use in blenders, feeders and conveyor systems is said to be dust-tight and self-cleaning. Metal-to-metal seat pre-



vents build up of material. Leading edge of rotating member cuts particle size of material as well as pushing it off seat. *General Machine Co. of N. J.*

CIRCLE NO. 36, PAGE 7-8

Flame cut-off machine is semi-portable, designed for heavy work in foundry scrap yards. Machine consists of 18 in. structural steel guide rail, a carriage and a torch truck which travels on a boom. The boom can be horizontally rotated around the center of the carriage. Torch truck and torch can be located anywhere within the

circle covered by the boom. Used for cutting stainless steels, alloy steels and cast iron; also skulls, thimbles and other scrap containing pockets of slag or refractory material. Torch can be adjusted 7 ft vertically, torch truck moves along the boom 8½ ft. *National Cylinder Gas Co.*

CIRCLE NO. 37, PAGE 7-8

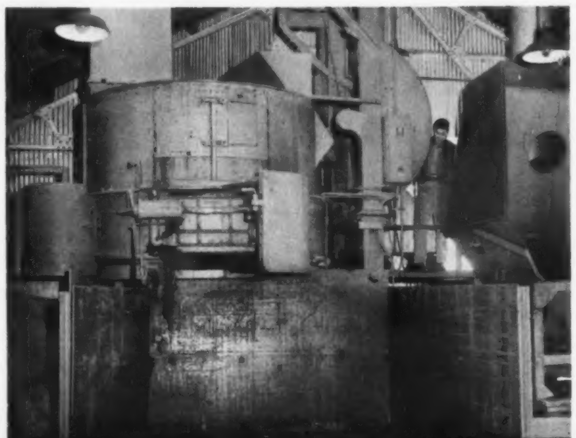
Belt conveyor features magnetic field keeping scrap on inclined belt. De-

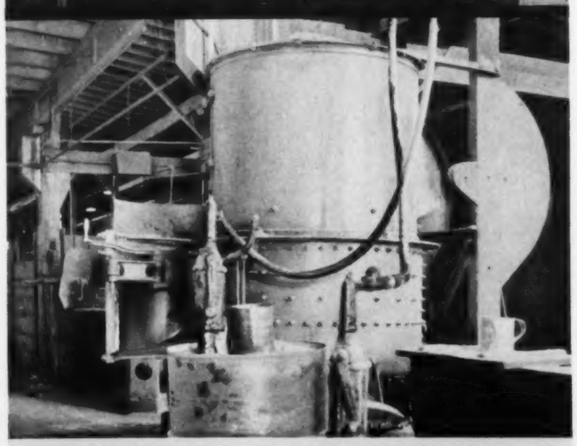
CIRCLE NO. 132, PAGE 7-8

outstanding

in Cincinnati...

✔ The first engineered castings show
✔ Mechanization in Cincinnati area foundries with B&P MACHINERY





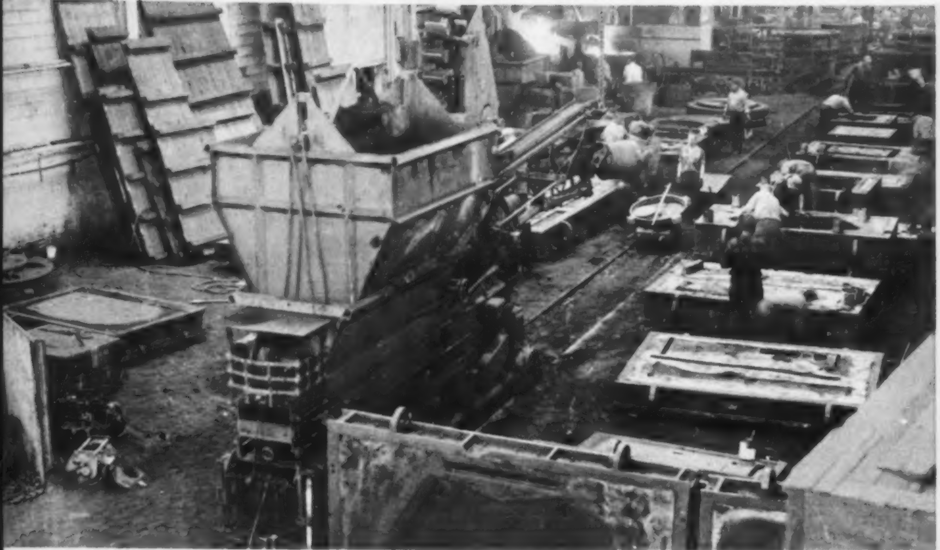
SPEEDMULLOR MULLING FOR MOLDING AND CORE SAND AT HAMILTON FOUNDRY & MACHINE—The Hamilton Foundry & Machine Company plant at Hamilton, Ohio, has a melting capacity of up to 25 tons per hour, and its customers are located throughout a wide area. This foundry must have quality and dependability. An "80-80" Speedmullor-Preparator Unit prepares molding sand for two of its units while two smaller Speedmullors handle core sand production. Results are high quality and low costs all along the line.

The eyes of the foundry industry are on Cincinnati for the First Engineered Castings Show ever held. Cincinnati has long been a leader in foundry mechanization and a few of the progressive foundries of that area that have mechanized with B&P machinery are shown here. An entire range of foundries from the smallest to the largest in this area use Speedmullors, Speedmullor-Preparator Units, Stationary Slingers, Motive Slingers, Flexiblo Core Blowers, and other B&P machinery to gain the advantages of mechanized operation. Many different approaches to the problem have been employed, but the result is the same in each case—a higher quality product produced at lower cost.

Ask for your copy of the
CONVENTION ISSUE OF BETTER METHODS MAGAZINE
featuring the Peerless Foundry of Cincinnati

90% OF TOTAL OUTPUT FROM MOTIVE SLINGER AT CHRIS ERHART—The 103-year-old Chris Erhart Foundry at Cincinnati is employing modern methods to produce a wide range of machine tool, pressure and other quality gray iron castings. Their Motive Slinger, purchased in 1946, has handled over 90% of their molding work ever since. The work is of a strictly jobbing nature with the majority of patterns of wooden construction.

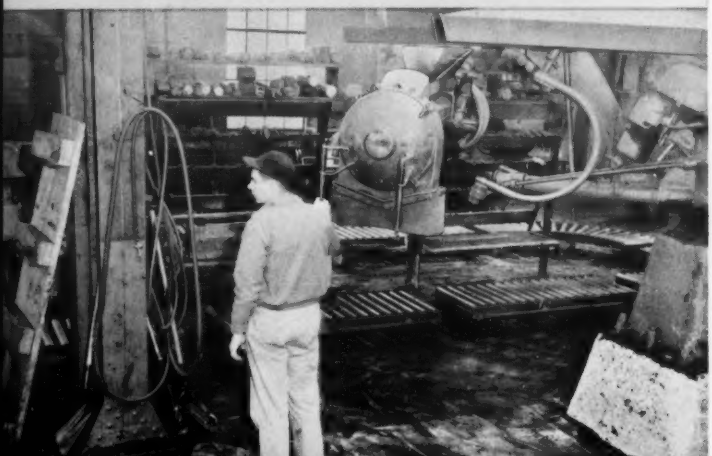
more foundries

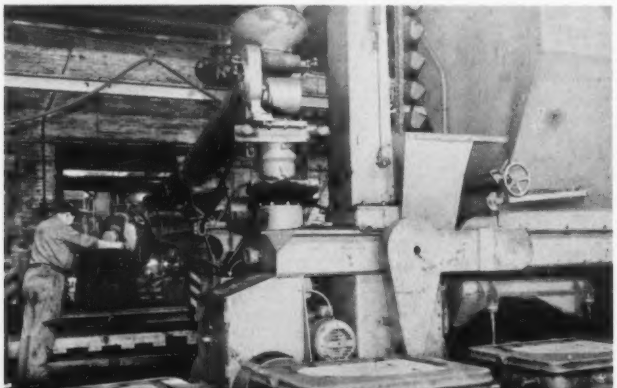


SLINGER RAMMING AND SPEEDMULLOR MULLING MEAN EFFICIENT OPERATION AT BLACK-CLAWSON—The big Black-Clawson foundry at Hamilton produces a wide range of large jobbing castings for paper mill machinery. A variety of miscellaneous castings are also sold to jobbing customers. The bulk of their molding is handled by a Motive Sandslinger. This slinger rams both pit and flask work with the biggest casting produced in the 45,000 lb. range. A Stationary Sandslinger and Speedmullor-Preparator Unit also do a big job at Black-Clawson's Keuthan Foundry Div. at Middletown, Ohio, and a Speedmullor-Preparator Unit and Motive Speedslinger handle the work at the company's Bagley & Sewell Div. at Watertown, N.Y.

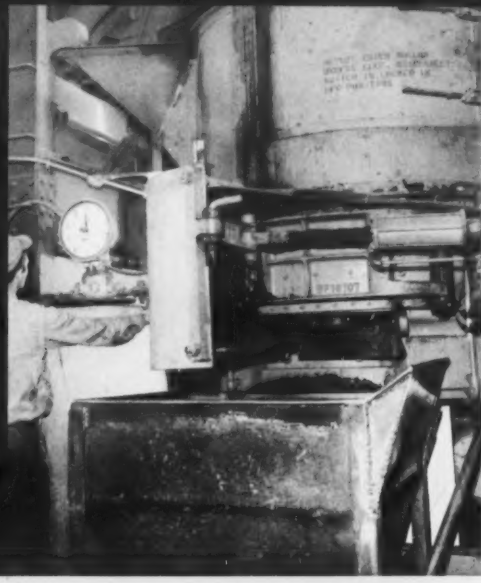
outstanding

CONVEYORIZED SLINGER MOLDING AT HAMILTON FOUNDRY & MACHINE—This compact Stationary Sandslinger installation handles a large portion of this foundry's medium size work. Flasks are rammed both on the conveyor and on the floor in the foreground. Rammed molds are moved by conveyor to finishing and storage area.





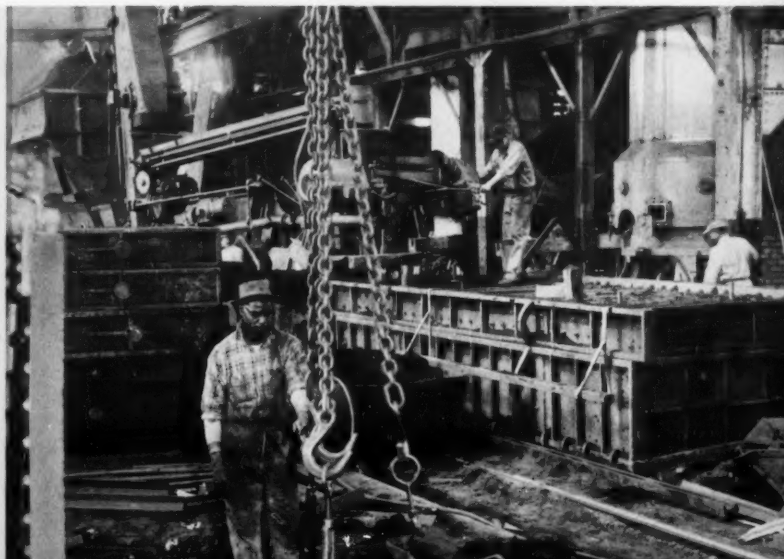
THREE SPEEDMULLORS AND A SLINGER REALLY PRODUCE AT DEUSCHER—The jobbing foundry of H. P. Deuscher Company at Hamilton, Ohio, is an important supplier to the machine tool, baking machinery and other plants in the area. Molds for complex castings weighing up to a ton are rammed by a Motive Sandslinger, which accounts for a large share of Deuscher's production. All of this shop's mulled sand is prepared by Speedmullor and Speedmullor-Preparator Units. Two Mullor-Preparator Units handle all of the molding sand, while a single Speedmullor processes all of the closely-controlled core sand.



AREA'S NON-FERROUS FOUNDRIES DEPEND ON SPEEDMULLORS—The progressive plant of Hamilton Brass & Aluminum Company is one of the outstanding non-ferrous foundries of the area. A great range of jobbing castings weighing from a few ounces to a thousand pounds are produced. The heart of the operation is a Model "40" Speedmullor (left) that prepares all of the foundry's synthetic molding sand. With Speedmullor control, a single sand is used for all of the molding. Mulling time is 60 seconds and the batch size is 500 lbs. The Reliable Castings Corporation of Cincinnati also depends on a Speedmullor (right) for all of their molding sand preparation. Reliable, one of the leading non-ferrous shops of the area, ships up to five tons of bronze and aluminum castings daily. Their "60" Speedmullor thoroughly prepares 80 to 100 tons of sand daily. The sand is mulled in 1,000 lb. batches and the mulling cycle is 60 seconds.

in Cincinnati...

SLINGER RAMMING PROVIDES FLEXIBILITY FOR ALL PIT AND FLASK MOLDING AT OBERHELMAN-RITTER—Up to 96% of the casting output at the progressive Oberhelman-Ritter Foundry is slinger rammed. This big shop ships up to 25 tons a day so the single Motive Sandslinger has to do a big job. The largest castings weigh up to 50,000 lbs. The pit mold in the foreground for a 40,000 lb. lathe bed has just been rammed and, in the background, the slinger rams the cope for an 18,000 lb. boring mill housing.

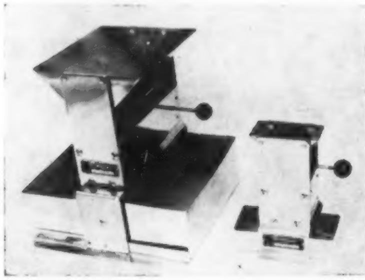


still more foundries ▶

signed for crowded areas, the light-duty cleated belt speeds transfer of scrap into tote boxes. May be moved by one man. *Rapids-Standard Co., Inc.*

CIRCLE NO. 38, PAGE 7-8

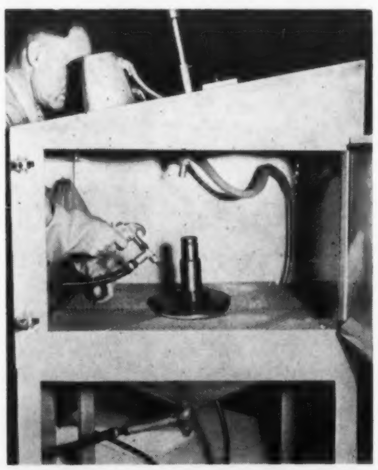
Sand sample splitter features stainless steel splitter blades. Samplers



provided with top hoppers having bottom discharge slot and cut-off gate. When gate is tripped, sample falls over blades into deep-drawn pans. Three models available: 16 divisions with 1/8-in. chutes; 32 divisions with 1/4-in. chutes; and 16 divisions split with 1/2-in. chutes. *Carpco Manufacturing, Inc.*

CIRCLE NO. 39, PAGE 7-8

Sandblast cabinet may be used with adjustable mounted blast unit or hand blast gun. Mounted unit may be raised or lowered in cabinet with action controlled by foot valve. Hand



gun recommended for difficult locations. *Cyclone Sandblast Equipment Co.*

CIRCLE NO. 40, PAGE 7-8

Flameproofing material applied to wooden flasks, bottom boards, benches or partitions reduces damage and fire hazards from metal spillage. Cloth also may be treated. Objects may

CIRCLE NO. 132, PAGE 7-8

char but will not burst into flame. Applied by dipping or spraying. *Foundry Rubber, Inc.*

CIRCLE NO. 41, PAGE 7-8

Vibrator operating on rotating, eccentric weight principle is designed for

use on structural steel storage bins. *Cleveland Vibrator Co.*

CIRCLE NO. 42, PAGE 7-8

Fork lift truck, 35,000 lb. capacity, places driver over fender for better visibility. Hydraulic system gives lift speed of 26 ft per min loaded. Unit is power shifted with speed of 16 mph in forward and reverse. *Clark Equipment Co.*

CIRCLE NO. 43, PAGE 7-8

Aluminum grating features riveted, rectangular openings. Said to remain structurally rigid regardless of cut-

outs made in panel. Unit has 79 per cent clear opening reducing maintenance. *Klemp Metal Grating Corp.*

CIRCLE NO. 44, PAGE 7-8

Vibrator, aluminum, is said to operate for 75 cents daily. Designed for use on railroad covered hopper cars. Vibrator anvil has flanged edges to fit standard female mounting brack-

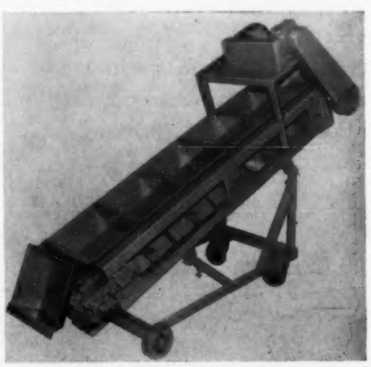
ets. Cast handle makes handling easier. *Burgess Sterbentz Corp.*
CIRCLE NO. 45, PAGE 7-8

Dust collector features centrifugal separator; designed to handle fibrous, granular, abrasive, fine or coarse dusts

at normal or high temperatures. May be operated on pressure or vacuum. Available in 20 sizes handling volume from 150 cu ft min. *Day Co.*
CIRCLE NO. 46, PAGE 7-8

Fork lift truck, 10,000 lb. capacity, features two-wheel drive and hydraulically-operated platform. Automatic unloading device prevents damage when platform reaches travel limit or when obstruction is hit. *Elwell-Parker Electric Co.*
CIRCLE NO. 47, PAGE 7-8

Trough conveyor, metal, for castings, liquids or powders. Construction eliminates hinges; stainless steel trough



resists corrosion. Unit is portable with 14-in. height. Length, width and shape adapted to suit application. *R. T. Sheehan Co.*
CIRCLE NO. 48, PAGE 7-8

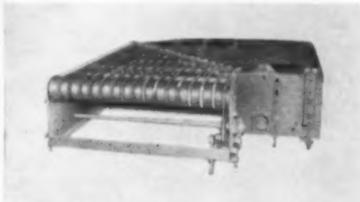
Burden carrier, battery operated, has 6000 lb capacity. Truck has 4 speeds forward and reverse and measures

CIRCLE NO. 135, PAGE 7-8

46 in. wide, 89 in. long and 33- in. high. Drive axle is double-reduction spiral bevel and spur gear unit. *Mercury Manufacturing Co.*

CIRCLE NO. 49, PAGE 7-8

Conveyor turning device allows 90 deg turns. Incorporates series of narrow belts running in grooved pulleys, meeting to provide an angular direction of flow. Belts banked for constant contact with material in motion; positive belt guides prevent side sheer as material changes direction. Slight differential in speed between the bank of belts produces a positive turning action. *Stewart-Glapat Corp.*

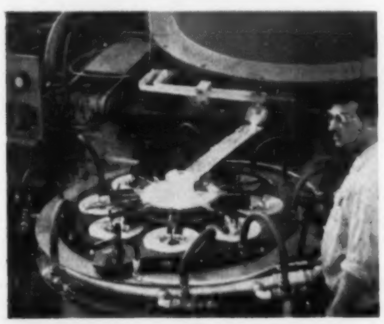


CIRCLE NO. 50, PAGE 7-8

Industrial lift platform, semi-portable, requires no installation. Platform, 6 x 9 ft, supports 5000 lb. Raised height of unit is 64-½ in., lowered it is 4-½ in. from floor to top of platform. Hydraulically operated; lift operates without underground piping. *Autoquip Corp.*

CIRCLE NO. 51, PAGE 7-8

Billet casting machine for continuous or semi-continuous production of nonferrous billets from 3 to 20 in. diameters. Loses less than 1 per cent of metal in gates. Grain size said controlled by regulating casting speed and metal temperature. Molds internally cooled by recirculated water. *Lobeck Casting Processes Inc.*



CIRCLE NO. 57, PAGE 7-8

Oxygen cylinder manifold accommodates any number of cylinders for welding, cutting or other industrial use. One bank of cylinders may operate with other in reserve. Both banks may be used for heavy flow of

gas. During alternate operations, reserve bank automatically furnishes oxygen when supply in operating bank is exhausted. *Linde Air Products Co. Div., Union Carbide & Carbon Corp.*

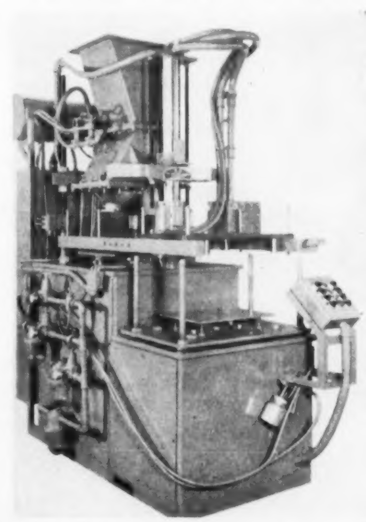
CIRCLE NO. 52, PAGE 7-8

Resin metering device pumps and delivers measured quantities of epoxy,

polyester resins and hardeners in fibre glass fabricating operations. Delivers as small as 10 grams and up to 3 lb. per min. *Auto-Air Industries, Inc.*

CIRCLE NO. 53, PAGE 7-8

Shell blowing machine, two-stage, rotary automatic, produces shell cores or shell molds. By blowing resin-coated sand into electrically heated boxes, shell cores or molds, ready for use,



are made within 30 sec. Hollow cores, solid cores, contoured shell molds, or liner cores can be made. Produces shell cores up to 12x20x30 in. height or shell molds up to 15x16x22 in. draw. Features include vertical or horizontal parting fixtures for handling hot core boxes or mold boxes; hydraulic system with cam controls for rotation and positive indexing.

Two stations operate 180 deg from each other. Only manual operation is removal of finished shells. Produces up to 120 blows per hour. *C&S Products Co., Inc.*

CIRCLE NO. 54, PAGE 7-8

Fork lift truck with scale attachment permits weighing on truck. Fork truck designed for close quarter work in

freight cars and trailers features compact size and short turning radius. *Automatic Transportation Co.*

CIRCLE NO. 55, PAGE 7-8

Shot and grit for foundry cleaning are said to reduce costs. Pearlitic malleable shot reported to give 10 per cent savings while another gives saving of 15 per cent. Materials shipped in palletized packages. *National Metal Abrasive Co.*

CIRCLE NO. 56, PAGE 7-8

Better Casting Qualities Shown in Magnesium Alloy

Good casting characteristics and response to solution heat treating and favorable mechanical properties have been achieved with a new Mg-Al-Zn alloy developed by the metallurgical laboratory of the Dow Chemical Co., Midland, Mich.

The alloy, AZ81A, has been used in production quantities and accepted as a standard alloy by the American Society for Testing Materials. It contains 7.6 per cent Al, 0.7 per cent Zn, a minimum of 0.13 Mn, and the balance Mg.

Tests indicate improved levels of both percentage elongation and tensile strength. Minimum values for these properties are raised significantly due largely to the ease of heat treating. It appears to be the most stable of the available alloys of this family.

CIRCLE NO. 138, PAGE 7-8

the editor's field report

by Jack Schaum

Designing With Radiography: More and more foundries are being equipped with x-ray equipment, betatrons, and capsules of cobalt-60 or radium for use in making radiographs of their castings. Increasing demands for radiographic sound castings by purchasers are behind this movement. As a result of having this equipment available, foundrymen are finding it a useful tool in designing the gating and risering systems for new casting jobs coming into their plants.

Utilizing past experience and judgment a first approximation is made as to gate and riser size and location. An experimental casting is made. By radiographing castings, gates and risers, shrinks and dirt are located. The indicated changes are made and the process repeated until the most efficient rigging is obtained that produces a sound clean casting. Such a system is more efficient than the tedious practice of cutting the casting into many slices in order to locate troubles.

One GMC foundry has used the radiograph technique with considerable success. As an extreme example they resorted to 257 radiographs in order to determine the most efficient system for a particular iron casting. Others have found that one radiograph tells more than a hundred saw cuts. If not already doing so, try this approach on your next problem-casting.

Another Record: In a conversation with T. E. Eagan, Cooper-Bessemer Corp., at the Malleable Founders' Society Technical and Operating Conference in Cleveland, he remarked that his appearance on the program marked the 63d time that he has presented a talk on the subject of nodular cast iron. Any other contenders for this record?

Cermet for Thermocouple Protection Tube: A metal-ceramic combination of 77 per cent chromium and 23 per cent aluminum oxide has a number of properties that make it attractive for thermocouple protection tubes at elevated temperatures. This material does not begin to soften until temperatures go above 2800 F. Repeated intermittent immersions at 3000 F have been successful. Although it has good resistance to oxidizing atmospheres and basic slags at these high temperatures, acid slags will attack the cermet. Thermal and mechanical shock must be avoided. Continuous immersion in molten brass and bronze has been no problem for protection tubes made of this material.

Nodular Iron Technique: While down in Birmingham at the Southeastern Regional Foundry Conference I was interested in learning about the International Harvester technique for minimizing magnesium losses when making nodular iron. By covering the ladle almost completely with a tight fitting cover and maintaining an argon atmosphere over the melt when the magnesium is added to the iron, the violent burning of the magnesium is held to a minimum. According to A. P. Alexander, works manager of the Memphis plant, they are using only one-fourth as much nodulizing alloy as formerly when using an open ladle. Further advantages accrue from the great reduction in magnesium oxide air pollution and the improved safety resulting from elimination of the "Vesuvius" reaction normally associated with magnesium additions to cast iron.

Enameled Aluminum: New aluminum alloys have been developed by the Aluminum Co. of America for porcelain enameling sheet and extruded shapes. According to word received from the Alcoa Research Laboratories a casting alloy which can be porcelain enamel coated will soon be available. Perhaps the cast aluminum bathtub and sink with an attractive serviceable glazed enamel finish is just around the corner.

Words of Advice: At the AFS California Regional, Harold E. Henderson, chairman of the Northern California Chapter, advised the visiting foundrymen "to go back to their foundries and improve their sand practices . . . and then tell me how you did it."

CIRCLE NO. 138, PAGE 7-8

CIRCLE NO. 139, PAGE 7-8

let's get personal

Lindberg Engineering Co., Chicago, has announced two appointments. **H. E. Pollard** has been named chief engineer of the Lindberg-Fisher Div., manufacturers of non-ferrous melting furnace and **O. S. Haskell,** former sales manager for General Electric Furnace and Oven Div., has joined the Lindberg sales staff and will operate from Greenwich, Conn.

Pittsburgh Metals Purifying Co., Northside, Pa., has announced the election of new officers: president, **R. E. Ferree**; board chairman, **J. R. Loutzenhiser**; vice-president, **A. L. Suto**; vice-president, **Joseph Schucher, Jr.** **C. E. Thompson** was re-elected secretary-treasurer.

H. H. Blosjo . . has joined Malleable Iron Fittings Co., Branford, Conn., as process engineer. He will be responsible for all technical services at the firm's steel foundry. Previously, Blosjo spent 27 years as chief metallurgist for Minneapolis Electric Steel Castings Co.

John F. Torley . . former assistant plant superintendent for National Malleable & Steel Castings Co.'s Sharon, Pa., plant, has been named general superintendent of the firm's Capitol Foundry Div., Phoenix, Ariz.

Birdsboro Steel Foundry and Machine Co. has announced the election of two new officers: **B. A. Kline** has been elected assistant vice-president and sales manager, and **J. L. Rose** has been elected works controller. Each has been with the organization more than 30 years.

R. W. Ruddle . . has been appointed technical manager of Foundry Services, Inc., Columbus, Ohio. He was head of the melting and casting section of the British Non-Ferrous Metals Research Association from 1947 to 1957.

J. C. Prendergast . . formerly consultant to European foundries for the International Cooperation Administration, has been reassigned to Tokyo to develop Japanese foundry capacity.

Orville Hoover, Jr. . . has been named foundry superintendent of Phillips & Buttorff Corp., Nashville, Tenn. He was previously with Wysong & Miles Foundry, Greensboro, N. C.

Aubrey Bukowski . . has joined the casting section, Metallurgy Div., Naval Research Laboratory, Washington, D. C. He was previously with Wehr Steel, Milwaukee.

Peter J. May . . has been appointed manager of foundry sales for Cleveland Quarries Co., Amherst, Ohio.

John C. Wallace . . has been named vice-president of engineering for the Walworth Co., Boston. He was for-

R. E. Ferree

H. H. Blosjo

R. W. Ruddle

merly vice-president and general manager of Hunt-Spiller Mfg. Corp., Boston.

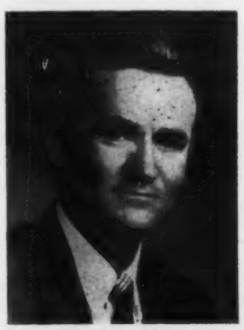
J. T. Conner . . has been named an abrasive engineer for Sterling Grinding Wheel Co. in the Youngstown, Ohio, area.

John Kempf . . has joined the technical staff of Furane Plastics, Inc., as a product development manager.

C. DeLaittre

Minneapolis Electric Steel Castings Co., Minneapolis, Minn., has promoted **Carter De Laittre** from superintendent to works manager, and has named **L. E. Alexander,** former plant engineer, to succeed De Laittre as superintendent.

John Matchulat . . has been promoted from superintendent of the crucible and refractories division of Electro Refractories and Abrasives Corp. to plant manager in charge of production.



L. E. Alexander

R. L. Horn . . has been appointed field test engineer for the Michigan area by the grinding wheel division of Electro Refractories & Abrasives Corp.

Electro Metallurgical Company, division of Union Carbide and Carbon Corp., has named two new district managers: **F. W. Hanson** in Houston, and **R. W. Wilson** in Chicago. Hanson has been a sales and metallurgical

CIRCLE NO. 141, PAGE 7-8

service engineer with the firm since 1939. Wilson joined the company in 1954.

J. G. Frischkorn . . has been appointed assistant sales manager of the Cleveland Tramrail Div., Cleveland Crane & Engineering Co., Wickliffe, Ohio.

J. Krall

Jackson Krall . . has been appointed sales manager for Milwaukee Malleable & Grey Iron Works, Milwaukee. For the past seven years he has represented the firm in Michigan and Ohio.

Peter Iaffaldano . . has been appointed a field engineer assigned to Norton Co.'s Cleveland district office.

Lawrence De Giso . . has been appointed a sales representative in the Chicago area by Lewis-Shepard Products, Inc., Watertown, Mass.

Edward A. Kooper . . former foundry engineer, American Radiator & Stand-

E. A. Kooper

ard Sanitary Corp., Bayonne, N. J., has been named development engineer, Gray Iron Research Institute, Inc., Columbus, Ohio.

U. S. Hoffman Machinery Corp., New York, has announced two new appointments: **L. S. List** has been named manager of the air appliance department, and **Raymond Boyd, Jr.,** has

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been named manager of the industrial divisions and foreign operations.

Grayson K. Bailey . . has joined American Fire Clay & Products Co., Canfield, Ohio, as a sales engineer for Illinois, Indiana, Wisconsin, and western Michigan. He was formerly with Blastcrete Service Sales, Inc.

C. F. Menzer

Charles F. Menzer . . has been appointed works manager of Alloy Steel Casting Co., Southampton, Pa. He was formerly chief quality control engineer for Cooper Alloy Co.

Joseph B. Gutenkunst . . has been elected president-treasurer of Milwaukee Malleable & Grey Iron Works to fill the post left vacant by the death of his brother, C. A. Gutenkunst, Jr. Both men had shared the general management of the firm since 1931. **William R. Kerner** was also elected secretary of the company and **F. A. Preiss** was elected assistant secretary-treasurer.

Milo L. Phillips . . has been named sales manager of Alloys & Chemicals

M. L. Phillips

Mfg. Co., Inc., Cleveland. He was formerly in sales and foundry consulting for Wm. F. Jobbins Co.

B. J. Alperin . . has been named development engineer for the Applied Research and Development Laboratory of General Electric Co.'s

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Foundry Department. He was previously non-ferrous metallurgist at the company's Erie foundries.

A. W. Gruer, Jr. . . has been appointed to the executive staff of Carondelet Foundry Co., St. Louis, as manager of sales and marketing. He was previously director of marketing research for Cessna Aircraft Co.

A. W. Gruer, Jr.

G. Blair Sheers . . president-general manager of Standard Horse Nail Corp., New Brighton, Pa., was named "Man of the Year" by the Upper Beaver Valley Junior Chamber of Commerce.

Baldwin-Lima-Hamilton Corp. has named **Charles Freundlich** and **N. C. Peskin** as sales engineers for Baldwin testing machines in New England.

W. B. Summers . . has been transferred to Carborundum Co.'s Cleveland-Pittsburgh district as coated abrasives field sales manager. He formerly held the same position on the Pacific coast.

Lloyd C. Farquhar . . past director of the American Foundrymen's Society and works manager of American Steel Foundries East St. Louis, Ill., plant since 1929, has retired.

John A. Krum . . has been named Cincinnati district sales manager for Pickands Mather & Co. He was formerly associated with the company's Cleveland sales office.

J. A. Gable . . has been named National Crucible Co. representative for Detroit and for the state of Ohio.

MORE FACTS on all products, literature, and services shown in the advertisements and listed in Products & Processes and in For the Asking can be obtained by using the handy Reader Service cards, pages 7-8.

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Steam Heat Treating Gives Parts Scale-Free Finish

■ Savings in tempering, annealing and stress-relieving of ferrous and non-ferrous parts have been realized through the use of steam atmosphere heat treating. In addition, it is claimed that machining and wearing qualities have been improved.

The furnace used is a batch-type unit designed for steam-atmosphere treating by electric heat and forced convection at temperatures up to 1250 F. For continuous production work about 50 lb. of steam is used hourly. The steam can come from either a plant line or a small steam generator. The steam feeds through an inlet in the furnace bottom and exhausts through a flapper valve in the lid. Electric heating is obtained by a continuous run of heavy-gage spiral wire surrounding the work space. A fan provides forced convection and uniform heating.

After the work has been loaded, the furnace is brought to 650-750 F which preheats the work and prevents condensation of steam. Automatic controls hold the preheat temperature for 30 min while injected steam purges air from the work chamber. The load is then heated to soak temperature and held automatically for the specified time. Following soaking, the work may be either air-cooled or oil-quenched. When handling non-ferrous materials which require lower soak temperatures, the furnace may be purged as low as 400 F and parts are often quenched in water.

Steel parts come out of the steam atmosphere clean and free from scale. During heat treatment, the steam forms a tightly-adhering blue oxide coating which protects the part. In a 30-min cycle at 1025 F, a coating 0.0001 in. is deposited.

The oxide coating has in itself a certain amount of resistance to corrosion. When the part is dipped in oil or other rust preventative, the oxide coating provides a highly retentive surface so that the corrosion resistance is said to be no less than if chemically oxidized.

If plating is required following heat treating, the oxide film is removed with a short pickle.

Brass and bronze parts are said to come out clean enough so that often additional chemical cleaning is unnecessary. Parts to be plated require only a bright dip to remove the slight discoloration. *F. L. Spangler, Leeds & Northrup Co.*

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C. V. Nass Elected to Presidency of F. E. F.

■ "Let's Look ahead" was the theme of the Tenth Annual College-Industry Conference of the Foundry Educational Foundation held March 13-14 at the Hotel Cleveland. The problem suggested by the meetings's theme, and whose solution is the foundation's purpose, is the recruiting and training of engineers.

President J. H. Smith, Central Foundry Div., General Motors Corp., reported in an address at the annual meeting that the development of the engineering educational program in cast metals continues at the 16 colleges and universities participating in the F.E.F. program. He stated that 155 scholarships were awarded by these schools during the first semester of the current school year and that 157 have been awarded so far during the second semester.

A decline in the number of students enrolled in foundry courses was noted in Smith's address. During the present school year, he reported, 4,772 students are enrolled in foundry courses, while 5,973 were enrolled a year ago. The decrease was attributed to revised curriculums at the F.E.F. schools. Smith noted, however, that while some shop courses usually offered at freshman and sophomore level were discontinued, enrollment in more advanced courses had increased.

Development of cast metals training in the F.E.F. schools was bolstered by their investment of a total of $105,550 in foundry laboratory facilities during the past year, Smith reported. A total of 73 faculty members are now engaged in teaching foundry courses, three more than the previous year's report.

The meeting was also the occasion for the election of new officers and trustees for the organization. New officers are: C. V. Nass, president; F. X. Bujold, vice-president. E. M. Knapp, secretary-treasurer; and E. J. Walsh, executive director, were reelected. New trustees are: T. T. Lloyd, R. M. Hill, A. V. Martens, W. O. Vedder, Phillip Lankford, R. P. Brewer, P. F. Bauer, Lloyd McNeil, J. H. Johnston, C. H. Ker, and R. B. Parker.

C. V. Nass, Beardsley & Piper Div., Pettibone Mulliken Corp., presided at Wednesday's opening session and F.E.F. President J. H. Smith, Central Foundry Div., General Motors Corp., gave the welcoming address.

Principal speaker of the opening session was Richard Meloy, market-

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ing director, Gray Iron Founders' Society, who spoke on the *"Marketing Aspects of Engineering Education in Cast Metals."* Marketing, a new ingredient in the industry, is the force that is developing new products for the foundry industry and engineering students must come to understand its importance, Meloy stated. He also discussed the G.I.F.S. survey of design engineers which found that 85 per cent of designers questioned wanted more information about castings.

Luncheon speaker Colin Carmichael, *Machine Design* magazine, identified the design engineer as the key man whose decision is important to the castings industry in his speech on *"Training Engineering Students in Cast Metals."* Foundries can perform an important bit of self-service by furnishing data and sample castings as examples for instructors in such subjects as machine design, he said.

Feature presentation on Wednesday afternoon was a panel discussion of *"Training Engineering Students in Cast Metals,"* which was moderated by G. K. Dreher, Steel Founders' Society of America.

Panelists and their subjects were: W. C. Jeffery, university of Alabama, *"The Development of Student Interest in Cast Metals;"* C. S. Crouse, University of Kentucky, *"Teaching Cast Metals in Engineering Curricula;"* B. W. Niebel, Pennsylvania State University, *"Industrial Activities on the Campus;"* J. F. Wallace, Case Institute of Technology, *"The Development of Scientific Literature in Cast Metals."*

Feature speaker at the annual banquet on Wednesday evening was Dr. R. C. S. Young who spoke on *"Why I am an American."* Dr. Young appeared through the courtesy of General Motors Corp.

The concluding activity of the conference was a panel discussion entitled *"The Engineering Graduate Moves into the Foundry Industry."* The discussion was moderated by H. F. Taylor, Massachusetts Institute of Technology.

Panelists and their subjects were: H. P. Skamser, Michigan State University, *"Recruiting Engineering Graduates;"* D. C. Ekey, Lebanon Steel Foundry, Lebanon, Pa., *"Training Young Engineers in the Foundry Industry;"* W. M. Dalton, Dalton Foundries, Warsaw, Ind., *"The Utilization of Engineers in the Foundry Industry;"* B. C. Yearley, National Malleable and Steel Castings Co., Cleveland, *"Growth and Development of Engineers in Industry."*

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committees in action

▪ All the trustees of the AFS Training & Research Institute were present for their second meeting on Feb. 24 in Point Clear, Ala. By unanimous vote a number of important decisions started the Institute program on its new path. S. C. Massari was appointed Director of the Institute and instructed by the trustees to employ a qualified educator to serve as Supervisor of Training.

During 1957 training courses have been scheduled in Industrial Engineering, Foundry Sand and Cupola Melting of Ferrous Metals. The next meeting of the Institute Trustees was scheduled for May 9 in Cincinnati.

▪ An interesting presentation at the 61st Castings Congress will cover liquid quenching of malleable iron; also the Promal process and Z metal. These plans were formulated in Chicago on Feb. 1 by the Pearlitic Malleable Committee. In spite of considerable work the committee has been unable to come up with a satisfactory impact test procedure for malleable iron. Not prone to give up, however, committee effort in this field will continue.

Chairman R. W. Heine summarized the hardenability work being conducted at the University of Wisconsin. As the result of running Jominy end quench hardenability tests on pearlitic malleable Heine has discovered that:

(1) Hardenability was uniform for the various samples submitted by the cooperating foundries.
(2) An increase in hardenability of manganese alloyed irons was indicated.
(3) The lowest hardenability values were obtained on a low silicon, manganese, chromium iron.

▪ Another Casting Clinic, so popular at the 1956 annual AFS meeting, was planned for the 61st Castings Congress by the Brass & Bronze Division Program and Papers Committee at their meeting in Buffalo on Feb. 1. At this Clinic, F. L. Riddell will lead discussion on gating; George Watson on sand; and R. A. Colton will handle castings design. Several other members will supply case histories.

The committee devoted the final period of its meeting to planning the agenda of papers desired for the 1958 convention.

▪ In order to determine the extent and nature of centrifugal casting operations in this country, the Centrifugal

Casting Committee is sending a questionnaire to all companies engaged in this type of production. The results of this survey will be used to guide future activities.

■ Progress continues on the preparation of the *"Radiation Protection Manual"* by the Radiation Protection Committee. Another chapter entitled "Internal Indicators of Radiation Exposure" has been completed. The excellent material contained in this chapter is indicated by the following summary which appears at the end of the chapter:

1) The complete blood examination should be more before employment, during employment (every two or three months), and after termination of employment in radiation exposure.
2) Examination of blood, bone marrow and urine should not be depended upon to indicate early radiation exposure.
3) The chief value of markedly abnormal blood, etc., findings would be to confirm that radiation exposure has already taken place.
4) The chief value of pre-employment and periodic complete blood counts is to enable exclusion or removal from radiation exposure of those who should be considered suceptible because of their blood pictures.
5) Interval health histories and symptomatology are just as important as blood examinations in detecting early indications of radiation exposure.
6) The best and safest system of radiation protection is achieved primarily through engineering control supplemented by medical control.

Coating of Boride Reduces Attack by Molten Aluminum

Protection of iron and steel parts against corrosive attack by liquid aluminum has been achieved by a boride coating. It is expected to facilitate the continuous processing and production of aluminum die castings.

The coating, announced by Penn-Texas Corp., consists of a boride base material which has excellent oxidation resistance up to 1800 F. It can be applied to a variety of steel and cast iron parts. Mild steel gives a better bond than stainless steel but the material can be deposited on a variety of stainless.

The boride coating is available as rods, 1 in. long and 1/8-in. in diameter. The rods are fed directly into a flame-spray gun. However, the application must be slow and accurate.

Transfer troughs when boride coated can withstand attack by streams of molten aluminum for long periods. Other applications have been made to wheels and pulleys for guiding steel wire through liquid aluminum.

pouring off the heat

Canadian gratitude

■ On behalf of the Metal Trades Section, Canadian Manufacturers' Assoc. (British Columbia Div.) I wish to express our deep appreciation for the cooperation, advice and assistance received from the American Foundrymen's Society in persuading City Hall to grant certain concessions to foundry operators in the matter of air pollution control.

As a result of the excellent work carried out by H. J. Weber, AFS Director of Safety, Hygiene and Air Pollution Control, and your Chapter Chairman, C. C. Smith, the authorities have seen fit to make certain revisions to the existing by-law, under which foundry operators now receive special consideration (by the removal of the Ringellman chart and a new method of measuring emission).

The untiring efforts of Mr. Weber and his expert knowledge of smoke control contributed greatly to the satisfactory outcome of the negotiations. I take this opportunity of expressing our gratitude to him and the AFS.

C. SPINK, Sec.
Metal Trades Sec.
Canadian Manufacturers' Assoc.

Nice work, Herb.—Editor

there'll always be a Scotland

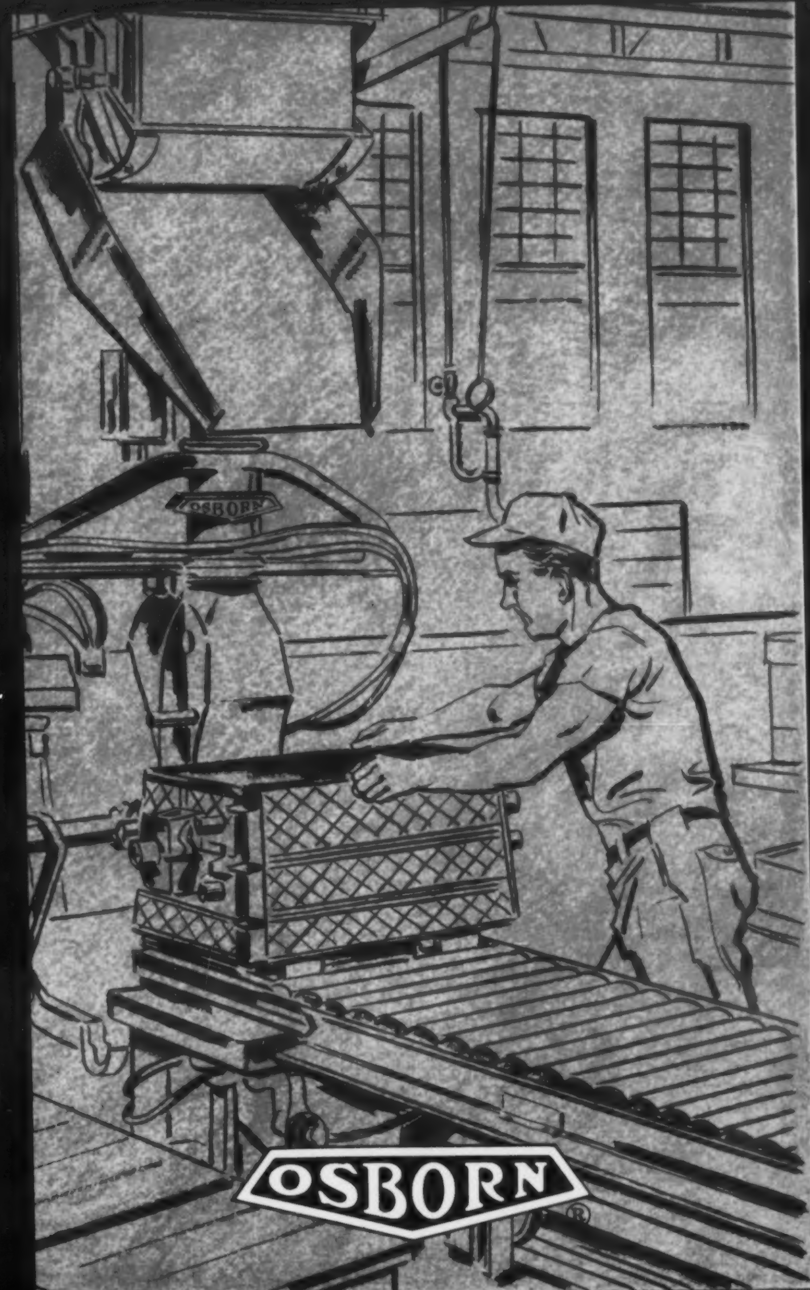
■ I was shocked to note from the article "Warm Blast Cupolas" in your January issue that Messrs. John Lang & Sons, Ltd. are located at Johnstone, England. John Lang & Sons are definitely a Scottish firm and would never claim to be an English company, since Johnstone is less than ten miles from Glasgow.

If you would kindly correct this error, we will try to keep down our desire to sharpen up our Claymores.

JOHN BELL
Albert Smith & Co.
Glasgow, Scotland

This error was noted and corrected in Pouring Off the Heat, April issue. Again our apologies.—Editor.

Answer questions by sending for data describing the newest products and processes. Order now by using the cards on **page 7-8.**



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new books

Notch Ductility of Malleable Irons . . G. A. Sandoz, N. C. Howells, H. F. Bishop, and W. S. Pellini (U. S. Naval Research Laboratory). 24 p. Office of Technical Services, U. S. Department of Commerce, Washington 25. 1956. 75c.

The notch ductility of malleable irons was investigated for conditions entailing the presence of sharp notches. The drop-weight test was used to establish nil ductility transition temperatures and the explosion crack-starter test was applied to establish the resistance to fracture propagation at temperatures above the NDT temperature. The results obtained from these tests were correlated with Charpy V notch tests. NRL R 4725.

A Practical Guide to the Design of Gray Iron Castings for Engineering Purposes . . (translation from the French) 56 p. The Council of Ironfoundry Associations, 14, Pall Mall, London, S.W.1, England. 1956. $2.

Prepared to help the designer understand the problems of the foundryman and thus help them work together to produce a satisfactory casting at the lowest possible cost. Four chapters include: 1. the properties of gray cast iron; 2. rules for sound design governed by structural factors; 3. design and feeding; and 4. design for reliable and economical molding. 104 line drawings, bibliography.

Yearbook of the American Bureau of (International) Metal Statistics . . 127 p. American Bureau of Metal Statistics, 50 Broadway, New York 4. 1956. $3.

This thirty-fifth annual issue reports for 1955 and prior years production and other economic statistics on worldwide basis for copper, lead, zinc, aluminum, gold, silver, tin, antimony, bauxite, cadmium, cobalt, magnesium, molybdenum, nickel, and platinum. Also contains tables of metal prices and lists of metallurgical plants and their capacities. Of interest to manufacturers and distributors of metal products and analysts of metal markets.

ASME Handbook: Engineering Tables . . Jesse Huckert (ed.) 704 p. Sponsored by the Metals Engineering Handbook Board of the American Society of Mechanical Engineers. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36. 1956. $12.

One of the four volumes comprising the ASME Handbook, this book is arranged in 15 sections, grouping together tables which apply to the design of specific parts. It covers such subjects as bar stock and shafting; bearings; spur, helical and herringbone, bevel and worm

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gears; cylindrical fits; keys and keyseating; bolts; springs, aircraft and mechanical tubing; serrations and splines; electrical motors, and gaskets. Other volumes of the ASME Handbook are: Metals Properties, Metals Engineering—Design, and Metals Engineering—Processes.

Precision Steel Castings for Aircraft Use . . National Research Council. 67 pp. PB 121148, Office of Technical Services, U.S. Dept. of Commerce, Washington 25, D.C. 1956. $1.75.

A survey of the present status and future possibilities of use of high-strength accurate castings (with particular emphasis on alloy steels) in aircraft construction. This includes an analysis of the problem, description of precision casting processes, present use of castings and forgings in airframes and aircraft engines, current government and industry research projects, and recommendations for future programs in research and development.

Dimensioning of Risers for Nodular Iron Castings . . H. F. Bishop and C. G. Ackerlind. 22 pp. PB 121091, Office of Technical Services, U.S. Dept. of Commerce, Washington 25, D.C. 1956. $0.75.

Riser requirements for hypoeutectic iron castings are a function of the carbon equivalent and of casting geometry. Casting geometry is described by a shape factor expressed in terms of the length, width and thickness of the casting; empirical graphs are used to interrelate riser volume, casting volume, shape factor, and carbon equivalent. Procedures are described also for the risering of complex, hypoeutectic iron castings consisting of joined sections of different thicknesses and geometries. Riser requirements for hypereutectic irons are found to be independent of casting configuration and are a function only of casting volume. The relation of the solidification characteristics of the two types of irons to risering requirements is discussed.

Molybdenum — Metallurgy of the Rarer Metals, No. 5 . . L. Northcott, 222 pp. Academic Press Inc., 111 Fifth Avenue, New York 3, 1956, $6.80.

This book brings together all information on molybdenum, with emphasis on the physical metallurgy. The material is organized into chapters as follows: History, occurrence, and uses; Extraction; Physical properties; Powder metallurgy, Arc melting fabrication; Mechanical properties; Alloys; Oxidation and protection; and Joining.

Radiation Safety and Major Activities in the Atomic Energy Programs, July-December 1956 . . United States Atomic Energy Commission, 396 pp. United States Government Printing Office, Washington 25, D.C. 1957, $1.25.

In addition to its report on major activities during the last six months of 1956, this Twenty-first Semi-annual Report of the Commission includes a special section entitled "Radiation Safety in Atomic Energy Activities." The special section reports on the record in all activities in

which the Commission and its contractors are responsible for protection of workers and the public, and summarizes the methods and administration of radiation safety, the provisions for protection of health and safety through regulation and licensing, the problems of controlling radiation hazards and the solutions found, and the results of biological and medical research, the effects of radiation upon man, and the treatments of these effects.

Chemical Engineering Practice (Volumes 1 and 2 of a twelve volume series) . . Herbert W. Cremer (general editor) and Trefor Davies (managing editor), Academic Press Inc., 111 Fifth Avenue, New York 3, 1956, $17.50 each, or $13.30 each if set of twelve is ordered.

Vol. 1 – General – 508 pp. This volume gives the general background of chemical engineering, including its origins and definition. Various experts from The Hague and Great Britain are contributors to sections of Economics of production, Investigation and development of an industrial process, Pilot plants, Flow diagrams, and Units, dimensions, and calculations.

Vol. 2 – Solid State – 655 pp. The sections include: Fundamental concepts of matter in the solid state, Metals and metallic alloys, Mechanical and physical properties of plastics and glasses, Corrosion of metals, Porous masses, and Powder metallurgy. The chapters in the Metals section are: Significance of mechanical properties and their measurement, Alloy equilibrium, diagrams, Range of steels, Fatigue in metals, and Creep in metals.

ASTM Book of Standards, 1956 Supplement, Pts. 1 and 2 . . American Society for Testing Materials, 1916 Race Street, Philadelphia 3.

Part 1 – Ferrous Metals, 452 pp. – Contains the revised standards and the new and revised tentatives that have been accepted since the 1955 book was issued.

Part 2 – Non-Ferrous Metals, 333 pp. Brings the 1955 book up-to-date by listing various changes and additions that have been made.

Defects and Failures of Metals – Their Origin and Elimination . . E. P. Polushkin, 399 pp. D. Van Nostrand Co., 120 Alexander St., Princeton, N.J., 1956, $12.50.

Information on each defect is divided into six separate sections: Definition and general characteristics; Origin, causes and contributing factors; Means of discovery or identification; Methods of testing; Occurrence, most common location or susceptibility; Detrimental effects; Prevention, correction, and elimination. Numerous illustrations and literature references are included.

An Encyclopedia of the Iron and Steel Industry . . A. K. Osborne, 558 pp. Philosophical Library, Inc. 15 East 40th St., New York 16, $25.

Descriptions and definitions of the materials, plant, tools, and processes used in the iron and steel industry and those

industries closely allied to it, from the preparation of the ore to the finished product. Appendices include: Conversion tables; Weights and measures; Properties (of steel); Signs and symbols; and a list of societies.

Foundry Air Pollution Manual . . 58 p. American Foundrymen's Society, Golf & Wolf Rds., Des Plaines, Ill. 1956. AFS members $4.25; others $5.50.
The goal of this book by the Air Pollution Control Committee of AFS is to provide the foundryman with technically correct information that will enable him to effectively formulate methods of controlling air pollution in his specific operation and locale. With such information, any foundryman will be able to determine what steps he should take to control air pollution in such manner that his plant may continue to operate as a good neighbor, and to comply with local air pollution ordinances now in effect or possibly forthcoming. This well-illustrated book contains chapters as follows: Statement of the problem; Review of existing ordinances—atmospheric pollution codes and control ordinances; Community relations; Meteorology and topography; Atmospheric sampling and analysis; Air Cleaning equipment; Operating methods improvements and maintenance of air pollution control equipment. Bibliography.

NANCY EDDY, *Librarian*
American Foundrymen's Society

Aluminum Alloy Evaluated

Research work on aluminum alloy 6066, an aluminum-magnesium-silicon copper-manganese-chromium alloy, at the Wright Air Developement Center, reveals that this alloy can be welded using 716 and 195 alloy fillers. The alloy was evaluated as a material for use in Air Force weapons systems. Extrusions exhibited mechanical properties superior to 6061-T6 alloy and approached those of 2014-T6 extrusions. Stress corrosion life was found to exceed 2943 hours, although the elongation was decreased to about two per cent after exposure.

This report PB 121497, *"Mechanical Property, Corrosion and Welding Studies on 6066 Aluminum Alloy,"* 36 pp. may be ordered from Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C.

It's easy to obtain product data with the postage-free Reader Service Cards provided on pages 7-8. Use them for information on advertised products, too. Just circle the key number appearing at bottom of the ad.

N.F.F.S. Annual Meeting Opens May 9 in Cincinnati

■ Non-ferrous foundrymen will attend two special national meetings of the Non-Ferrous Founders' Society in Cincinnati, Thursday, May 9. Open to all foundrymen, the two meetings will be held in the Netherland-Hilton Hotel during the Castings Congress and Engineered Castings Show of the American Foundrymen's Society.

In addition to the open meetings, the N.F.F.S. board, with National President E. J. Metzger, president of Multi-Cast Corp., Wauseon, Ohio, presiding, will hold its annual meeting.

First meeting on May 9, the N.F.F.S. Government-Industry Luncheon and afternoon session, will be held at 12:30 pm in Parlor G. Featured will be talks by B.D.S.A. representatives, a report on the N.F.F.S. consumer survey, the president's review of society activities for the past year, and a panel discussion entitled *"What to Do About Rising Costs."*

B.D.S.A. speakers will be Wm. A. Meissner, deputy director of the copper division, and Manley Brooks, deputy director of the aluminum & magnesium division.

Resume of customer ideas on non-ferrous castings and castings producers, business practices, purchasing attitudes, future consumption of castings, and suggestions for improving customer relations—brought out in the consumer survey—will be presented by M. E. Nevins, president, Wisconsin Centrifugal Casting Co. Inc., Waukesha, Wis., N.F.F.S. director and chairman of the society's standardization and product development committee.

N.F.F.S. President Metzger will appear in a dual role at the luncheon, giving his "state of the society" address and also participating in the rising costs session along with Wm. A. Gluntz, president of Gluntz Brass & Aluminum Foundry Co., Cleveland, and chairman of the cost committee.

Highlighting the evening of May 9 will be the N.F.F.S. Annual Banquet at 7:00 pm, preceded by a reception at 6:00 pm, both in the Restaurant Continental of the Netherland-Hilton Hotel. Banquet speaker will be Fred Smith, president of Fred Smith Associates, Cincinnati management consultants. His talk will be "Responsibility of Privilege."

Answer questions by sending for data describing the newest products and processes. Order by using cards on **page 7-8.**

H. F. Park Re-Elected President of S.F.S.A.

■ Howard F. Park Jr., General Steel Castings Corp., Granite City, Ill., was re-elected president of the Steel Founders' Society of America at the annual meeting held March 18 and 19 at the Drake Hotel, Chicago.

B. P. Hammond, Eastern Casting Sales, Foundry and Mill Machinery Div., Blaw-Knox Co., Pittsburgh, Pa., was vice-president, and R. G. Parks, National Malleable and Steel Castings Co., Cleveland, was elected treasurer.

Howard F. Park, Jr., named to head S.F.S.A. another year.

Allen M. Slichter, Pelton Steel Casting Co., Milwaukee, chairman of the society's market research committee, was awarded the Lorenz Memorial Gold Medal in recognition of his outstanding services to the industry.

Henry D. Phillips, Adirondack Foundries & Steel Inc., Watervliet, N. Y., retiring chairman of the society's technical research committee, was awarded the Technical & Operating Gold Medal for his services as chairman of this committee over a 5-year period and for other activities which have benefited the country and industry.

Henry D. Phillips, accepts T&O Gold Medal from H. F. Park.

E. E. Hucke of the University of

Michigan received the Gustav A. Lillieqvist Steel Foundry Facts First Place Award for his article *"High Amperage Magnaflux Inspection"* and Norman F. Koch, Grede Foundries Inc., Milwaukee, took second honors with his paper *"A Study of the Ceroxide Cope Defect and Eroded Sand"*.

Newly elected directors of the Society are: C. R. Wyckoff, Jr., Atlas Steel Casting Co., Buffalo, N.Y.; B. P. Hammond, Eastern Casting Sales,

Allen M. Slichter, awarded Lorenz medal for his service.

Foundry and Mill Machinery Div., Blaw-Knox Co., Pittsburgh, Pa., J. W. Perry, Jr., Grede Foundries Inc., Milwaukee; E. F. Marquardsen, Pacific Steel Casting Co., Berkeley, Calif.

Continuing directors are: M. G. Moore, Jr., Empire Steel Castings Inc., Reading, Pa.; J. M. Kincaid, Jr., Kincaid-Osburn Electric Steel Co., San Antonio, Texas; R. A. Thompson, Electric Steel Castings Co., Indianapolis; W. H. Muchnic, L.F.M. Div., Rockwell Mfg. Co., Atchison, Kans.; H. F. Park, Jr., General Steel Castings Corp., Granite City, Ill.

Staff officers elected by the Board of Directors are: F. Kermit Donaldson, executive vice-president and secretary; Charles W. Briggs, technical & research director; George K. Dreher, former secretary, to the newly created office of market development director; Robert A. Willey, asst. technical & research director; Erwin Dieckmann, to the newly created office of assistant secretary.

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61st afs CASTINGS CONGRESS and 1st ENGINEERED CASTINGS SHOW

"Quality, Utility, Economy of Cast Metals," will be demonstrated in exhibits and discussed in technical presentations at the 61st Castings Congress and 1st Engineered Castings Show of the American Foundrymen's Society to be held at Cincinnati, May 6-10. This event marks the first time that foundrymen have joined efforts to tell the story of developments in foundry techniques and materials to the designers and buyers who specify and purchase castings.

Frank W. Shipley, president of the American Foundrymen's Society, will preside at the official events of the Castings Congress.

The program of technical papers, round table luncheons, and shop course sessions arranged by the more than 100 technical committees of AFS has been planned as a presentation of advancements in technology that affect both the casting designer and the foundryman. Authors from many sections of the free world will contribute to the technical sessions. Britain will contribute several papers in addition to its official exchange paper. France will present an official exchange paper from Association Technique de Founderies and other papers from Switzerland, Norway, and Australia will reflect the universal scope of the study of cast metals. A complete program of the technical events of the Castings Congress was published in the April issue of Modern Castings and the highlights of the program are summarized in this article.

Concrete evidence of the accomplishments of the castings industry will be displayed in some 100 exhibits that comprise the 1st AFS Engineered Castings Show. The exhibitors are foundries, pattern shops, metals and alloys producers, and testing equipment manufacturers.

Exhibits at the Engineered Castings Show will emphasize the mod-

ern techniques, materials, and methods employed in foundries to produce castings with the highest quality and the greatest economy and utility. Foundry exhibits will demonstrate the controls, special alloys, and unusual services available to their customers.

Television will be used by one foundry exhibitor to show visitors to its booth a live picture of production in its Cincinnati plant. Such a demonstration has never before been given at any trade exhibit.

A complete list of foundries, pattern shops, and other firms exhibiting in the Engineered Castings Show appears starting on page 62.

Business meetings, social gatherings, a special program for ladies, and tours of foundries in the Cincinnati area will round out a week of activity.

The 1st Engineered Castings Show and a number of important technical and engineering sessions will be held in the Cincinnati Music Hall. Other technical sessions, luncheon meetings, and author-chairman breakfasts will be held in hotels near the Music Hall.

▪ **Registration.** Registration booths for the Castings Congress and Engineered Castings Show will be maintained at the main entrance to the Music Hall and on the third floor of the Netherland-Hilton Hotel. The registration fee for AFS members, non members, and for visiting designers and buyers is $2.00. Admittance to the exhibits and to the technical sessions is by badge only.

To avoid delay at the registration desks, the visitor to the Castings Congress may complete both registration cards printed on page 85 in the February Modern Castings and present these at the desk.

Tickets to the AFS Annual Dinners, and to all official luncheon and dinner events will be on sale at both registration centers.

The special registration books for old timers in the castings industry and for overseas visitors will also be located in the registration center. Congress-goers with 25-or-more and 50-or-more years of service in the industry will receive appropriate recognition pins.

The International Registration book will be maintained as a convenience to overseas visitors who will want to contact friends.

▪ **Feature speakers.** Three speakers featured in the technical program will outline present and future development in metal casting. The Hoyt Memorial Lecture will be given by Hyman Bornstein on the topic *"Progress in Iron Castings."* Bornstein is a past president of AFS and received the McFadden Gold Medal in 1946.

A management development program will be initiated at this convention. William J. Grede, president, Grede Foundries, Inc., will discuss *"Developing Foundry Management."* The speaker is a past president of National Association of manufacturers.

The third speaker whose topic will attract unusually wide interest is Harry F. Barr, chief Chevrolet Motor Div., GMC, who will present an illustrated talk on *"An Automotive Engineer Views the Foundry."*

Barr will speak Monday, May 6, at 2:30 pm in a session titled "Castings Engineering." No other technical events have been scheduled for this hour so that all foundrymen may attend to hear the views of the automotive industry, largest consumer of their cast products.

▪ **Business Meeting.** President Frank W. Shipley will present the President's Annual Address at the business meeting which will start at 9:30 Wednesday morning, May 8. Election of officers and awards to winners of the Robert E. Kennedy Apprentice Contest will also take place at this time.

The first presentation of the new AFS Service Citations and the AFS Award for Scientific Merit will be another feature of the business meeting. Details of the new awards are on page 57. The meeting will be held in the auditorium of the Music Hall.

The Charles Edgar Hoyt Annual Lecture will immediately follow the business meeting at 11:00. Exhibits will not be opened during the business meeting and lecture.

▪ **Annual Dinner.** *"The Seventh Inning Stretch,"* a speech by Warren Whitney, National Cast Iron Pipe Div., James B. Clow & Sons, Birmingham, Ala., will be the feature of the AFS Annual Dinner which will be held Wednesday evening, May 8, in the Pavillon Caprice of the Netherland-Hilton Hotel.

During the dinner, AFS Gold Medals and honorary life memberships in the American Foundrymen's Society will be presented.

TECHNICAL PROGRAM

▪ Money could not buy the foundry team of over 150 top technical men responsible for more than 100 papers, reports, shop courses, and panel discussions scheduled for presentation at the 61st Castings Congress! The highlights of this kaleidoscope of foundry information is presented here. For more complete details see the Official Program in April Modern Castings.

▪ **Author-Chairman Breakfasts.** To insure a smooth operating technical program, an authors' breakfast will be held each morning. Attending will be the authors and technical chairmen for that day and AFS Technical Director S. C. Massari. The day's program will be

Cincinnati Music Hall, site of the AFS 61st annual meeting.

Major technical and engineering sessions will meet in the Music Hall auditorium.

discussed in detail and final arrangements completed. The breakfasts will be held each morning during the Castings Congress at 7:30 in Parlor G, Netherland-Hilton Hotel.

■ **Technical Luncheons.** Round Table Luncheons will be held every day at noon with outstanding speakers scheduled to talk. The Steel Luncheon is on Monday, Malleable and Pattern, both on Tuesday, Management on Wednesday, Light Metals on Thursday, and Gray Iron on Friday.

■ **Shop Courses.** Another outstanding series of Shop Courses have been set up to appeal to foundrymen desiring to learn and participate in discussions on subjects close to their daily problems. These sessions are open to everyone with no registration fee required.

The Shop Course on Malleable Iron will be held Monday night, Sand will be Tuesday night, and Gray Iron Thursday night. A second Gray Iron Shop Course will be held on Friday afternoon at 2:30 pm.

■ **Brass and Bronze.** A Castings Design Clinic will be conducted by the AFS Brass and Bronze Division under the guidance of F. L. Riddell, G. F. Watson, and R. A. Colton.

The official exchange paper from the Association of Bronze and Brass Founders (United Kingdom) is entitled *"Cooperation for Technical Advancement in the British Bronze Foundry Industry"* and is authored by A. H. R. French and E. C. Mantle. Papers will also be presented on gun-metal (88-8-4), cupro-nickel, and other copper-base alloys.

■ **Education.** Education and its importance to foundries will be covered in two sessions. On Wednesday, *"The Coming Foundry Manpower Shortage,"* the second and final report of a study made jointly by a committee of foundrymen and the U. S. Department of Labor will be presented.

Thursday a three-man panel will discuss *"Meeting Your Manpower Needs."* Included in the panel is S. C. Massari, AFS Technical Director, who will outline the plans, program and scope of the AFS Training and Research Institute.

■ **Fundamental Papers.** Building a strong foundation of foundry fundamentals and constantly adding to it is the task of the AFS Fundamental Papers Committee.

A paper from M.I.T. presents a study of fluidity of magnesium while one from the University of Michigan is on aluminum fluidity. From the Naval Research Laboratory comes more valuable information on the subject of "hot-tearing". A Norwegian, Fredrik Hurum, has contributed a paper entitled *"Action of Ferrosilicon as Inoculant in Cast Iron and Effect of Magnesium."*

■ **Gray and Nodular Iron.** Of basic importance to all foundrymen will be the AFS sponsored Research Project report on gating. Interest in *"Carbon Refractories"* by G. B. Tatum should be high. Battelle Memorial Institute will present a paper showing that tin can be a valuable alloying element.

The quality of research conducted by the British Cast Iron Research Assoc. will be demonstrated in a paper *"Temper Embrittlement in Nodular Irons"* by G. N. R. Gilbert. The first report of the new joint AWS-AFS Committee will come from a panel of members on the subject *"Welding of Gray, Nodular, and Malleable Iron"*.

The Gray Iron Luncheon has scheduled G. W. Schuller, Jr. and W. T. Schmidt to talk on *"Economical Casting Design and Production.*

Heavy demand required two Shop Courses to be held. The first one on *"Basic Microstructures as Steps to Quality Castings* will be conducted by L. L. Clark, Armour Research Foundation. The second course will cover *"Inoculation as a Step to Quality Castings"* with D. E. Krause at the head of the class.

■ **Heat Transfer.** A report on the AFS-sponsored research project of the Heat Transfer Committee, *"Temperature Drop in Pouring Ladles,"* by V. Paschis and J. W. Hlinka will be the second paper resulting from the study. In a second paper, the same authors discuss *"Some Generalized Solidification Studies."* Two additional heat transfer papers will be given by authors from M.I.T.

■ **Industrial Engineering.** Industrial engineering sessions will be conducted Thursday and Friday. One of the highlights will be *"An Appeal to Foundry Executives,"* by J. A. Wagner, Wagner Malleable Iron Co., Decatur, Ill.

The necessity of designing plant layouts to cope with production problems are brought out in two papers. A motion picture on operations in a steel railroad car wheel plant will also be shown.

The Management Luncheon will be held at noon Wednesday. W. J. Grede, Grede Foundries, will discuss *"Development of Foundry Management."*

■ **Light Metals.** Design engineers as well as foundrymen will be amazed at the rapid advances that are being made in the field of light metals. Titanium is changing from a "wonder metal" into a "working metal" because of the progress that is described in the three papers being presented on Tuesday afternoon at 2:30 pm.

Other papers are aimed at improving physical properties of alloy 356 and 195 by holding impurities down to a low level, using extensive chilling techniques, and through the use of alloy additions. R. F. Dalton will describe an unusual solution to the problem of coring small intricate passageways in light metal castings.

The growing importance of die casting is recognized by devoting an entire session to four papers on this subject.

The Light Metals Round Table Luncheon program fits the theme of the Engineered Castings Show. A panel discussion on *"Engineered Light Metal Castings"* will be led by Fred Mason, Chrysler Corp. and C. M. Curtis, Maytag Co.

■ **Malleable Iron.** Malleable iron foundrymen will find a full program to attract their attention. Six technical papers, a round table luncheon, and a shop course have been arranged by the AFS Malleable Iron Division. The growing interest in pearlitic malleable prompted the AFS Pearlitic Malleable Committee to survey the practices of 11 foundries and present their findings in a comprehensive report entitled *"Comparison of Properties of Liquid- and Air-Quenched Pearlitic Malleable Irons."*

The effects of several processing variables in the production of pearlitic malleable at the National Malleable and Steel Castings Co. will be presented by H. H. Johnson and W. K. Bock. Culminating a number of years research sponsored by AFS at the University of Wisconsin, E. H. Belter and R. W. Heine will present a summary entitled *"Effects of Charge Materials and Melting Conditions on Properties of Malleable Iron."*

C. A. Koerner will describe how the Central Foundry Div., GMC, uses cobalt radiography to improve gating and sound waves to weed out defective castings.

Of interest to design engineers as well as castings buyers and producers, the Malleable Round Table Luncheon will feature Thomas Logan telling about Caterpillar Tractor Co. experiences as a large purchaser as well as producer of castings. The evening Malleable Shop Course brings together a panel of eight men on the subject of Graphitization theory and mechanics.

■ **Patternmaking.** The growing importance of plastics in patternmaking is emphasized by four technical papers dealing with the use of epoxy resins and other plastics. The papers will outline the techniques and procedures needed to produce faster and cheaper patterns.

Methods of sealing coreboxes against blowbys will be described by R. C. Olson.

■ **Sand.** There is something for every foundryman in the Sand program which contains 12 technical papers, a Sand Division Dinner, and a Shop Course. George DiSylvestro may have the answer to your veining problem in the 77 color slides prepared in his study of veining tendencies of steel core sand mixes. Most green sand foundrymen want to know *"How to Determine Moisture Requirements of Molding Sands"* and R. W. Heine, E. H. King, and J. S. Schumacher have the answer in their paper.

A new hot strength test has been developed at the Naval Research Laboratory by N. C. Howells, R. E. Morey and H. F. Bishop. Their paper *"Properties of Molding Sands Under Conditions of Gradient Heating"* gives some new explanations for tearing.

From Switzerland comes a paper by G. Moser describing a European self-curing oil binder which permits production of sand cores without baking. *"Correlation Between Casting Surface and Hot Properties of Molding Sands"* is a

A well-rounded business background combined with a sense of humor have made Warren Whitney, Vice-President, James B. Clow & Sons, Inc., a successful executive and a popular speaker. He has earned the reputation of an entertaining speaker with a message.

Mr. Whitney worked as an industrial engineer, sales engineer and in public relations in the electric utilities field before entering the foundry industry. He started his career with Clow in 1937, became manager of the National Cast Iron Pipe Works, Birmingham, Fla., in 1940, and vice-president of the parent company in 1946.

BANQUET SPEAKER
WARREN WHITNEY

HOYT LECTURER
HYMAN BORNSTEIN

Recognized as a leading metallurgist and authority on cast iron, Hyman Bornstein will deliver the Charles Edgar Hoyt Memorial Lecture on "Progress in Steel Castings." Now retired after 33 years service with Deere & Co., Mr. Bornstein has served AFS in numerous capacities . . . as a sponsor of the Quad City Chapter, National Director 1932-1935, AFS President 1937-38, Chairman of the Cupola Research Committee and Trustee of AFS Training & Research Institute 1957-1961. In 1946 he was awarded the Wm. H. McFadden Gold Medal of the Society for his many technical contributions to the industry, particularly in gray iron technology.

report by AFS Committee on Physical Properties of Iron Foundry Molding Materials at Elevated Temperatures.

The Sand Division Dinner will feature a movie prepared by General Motors Corp.

A distinguished panel of sand experts will preside at the Sand Shop Course which will be devoted to sand control as a means of obtaining casting quality with the most economical practices.

▪ **Safety, Hygiene and Air Pollution Control.** *"Health and Safety,"* official exchange paper of the Institute of British Foundrymen will be presented by Sir George Barnett, British Labor Ministry official.

Following the British exchange paper on Monday, H. J. Weber, AFS Director of Safety, Hygiene and Air Pollution Control, will review recent or pending legislation affecting foundries in the United States and Canada.

On Tuesday, a second safety program will be held. Dr. P. J. Whitaker, Allis-Chalmers Mfg. Co., will discuss the importance of pre-employment and periodic audio-grams.

F. A. Van Atta, National Safety Council, Chicago, will discuss the hazards of radiation.

▪ **Statistical Control.** Application of statistical methods to achieve quality control has received increasing attention in recent years. The advantages and procedures for putting these controls into effect will be detailed in six papers.

▪ **Steel.** Steel technology papers scheduled go beyond this country to the *"Steel Foundry Industry Behind the Iron Curtain"* via the first hand observations of J. A. Kiosler.

From the opposite side of the globe foundrymen will learn from Hedley Thomas about *"Austenitic Manganese Steel Technology in an Australian Foundry"*. Design and casting engineers will learn about a steel formulated by American Steel Foundries for superior service under dynamic loading. For those interested in *"Grain Refinement of Stainless Steel Castings"* J. L. Walker, General Electric Research Laboratories will have some valuable information.

HIGH LIGHT ACTIVITIES

■ Although the Engineered Castings Show and the technical program of the Castings Congress occupy the center rings of activity, a number of other important functions are blended into this busy week in Cincinnati.

▪ **Plant visits.** List of foundries open for inspection starts on page 102.

▪ **Publications.** Publications of the American Foundrymen's Society will be available at an AFS publications booth at the registration center in the Netherland-Hilton Hotel and at a combined AFS publications-MODERN CASTINGS booth at the main entrance to the Music Hall.

Available at the publications booths will be three new AFS books: the revised AFS CAST METALS HANDBOOK, DESIGN OF DIE CASTINGS, and RECOMMENDED SAFETY PRACTICES FOR THE PROTECTION OF WORKERS IN FOUNDRIES.

The AFS CAST METALS HANDBOOK will be on sale in a completely revised, fourth edition. The 324-page volume includes data on the latest developments in the cast metals field and contains six chapters and 41 sections ranging from advantages of castings to metallurgical properties.

DESIGN OF DIE CASTINGS has been translated by an AFS committee from a German book by Gustav Lieby. This new, 208-page volume has seven chapters that cover die casting from the principles involved in this method of casting through design criteria for various alloys and a discussion of determining tolerances for die castings.

The new AFS safety manual was developed by the Safety Committee of the Safety, Hygiene, and Air Pollution Control to replace a previous manual published in 1940.

it recommends safe practices that pertain to all branches of the metal casting industry.

▪ **Ladies Program.** A scenic boat trip down the Ohio river, a Luncheon-Fashion show and a Ladies Tea will be the highlights of the Ladies Program.

Ladies are requested to register and secure tickets for events they desire to attend. Registration will start Monday, May 6 at 9 am at the Netherland-Hilton Hotel. Program highlights are as follows:

Monday, May 6, 3-5 pm: Official AFS Reception and Tea, Pavillon Caprice, Netherland-Hilton Hotel.
Tuesday, May 7, noon: Luncheon and Fashion Show, Sinton Hotel.
Wednesday, May 8, 7 pm: AFS Annual Dinner.
Thursday, May 9, 10:30-2:30: Ladies Boat Trip, leaving from foot of Sycamore St., Green Line Steamer's dock.

Wives of Cincinnati Chapter members are serving on the Ladies committees. Mrs. Frank W. Shipley and Mrs. Harry W. Dietert will serve as honorary co-chairmen.

▪ **Apprentice Contest.** The success of the educational programs to attract and train young men in the foundry field will be highlighted by exhibiting the winning entries in the 1957 Robert E. Kennedy Memorial Apprenticeshop Contest. display will be the winners in each of the five divisions in the contest.

▪ **Special dinners.** Three dinners for special groups will be held during the Castings Congress: the Sand Division Dinner, the Canadian Dinner, and the AFS Alumni Dinner.

Controlling Quality on the Chevrolet Cylinder Block Casting, a motion picture showing the controls employed by Chevrolet in handling sand from the time it is dredged from the lake until it becomes a finished core, will be the feature of the Sand Division Dinner. Comments by W. C. Schartow, Chevrolet Gray Iron Foundry, GMC, will supplement the movie. The dinner will be Wednesday evening at the Netherland-Hilton Hotel.

The Canadian Dinner for foundrymen from the Dominion will be held Wednesday, May 8, at the Sheraton-Gibson Hotel.

The annual dinner meeting of the "official family" of AFS—present and past officers, medalists, honorary life members—will be held the evening of Thursday, May 9, at the Queen City Club.

▪ **Past Presidents' Luncheon.** The traditional gathering of past national presidents of AFS is set for Thursday, May 9, in Parlor I, Netherland-Hilton Hotel. Past President F. J. Dost will preside.

▪ **AFS Institute.** Trustees of the AFS Training and Research Institute will meet Tuesday morning, May 7, in Parlor J, Netherland-Hilton Hotel, to discuss their growing program of training classes for foundry personnel.

AWARDS OF SCIENTIFIC MERIT

AWARDS OF SCIENTIFIC MERIT—"Intended exclusively as a technical citation . . to recognize outstanding papers, meritous technical services or effort, and development of a process, method or engineering advancement having future possibilities."

MANLEY E. BROOKS

"For technical assistance to the AFS Light Metals Division since its inception, and to the castings industry, especially in the field of magnesium alloys."

Mr. Brooks foundry engineer, Dow Chemical Co., Bay City, Mich. has been active in the cast magnesium field since 1928 in research, production and technical sales.

RICHARD W. HEINE

"For valuable assistance to AFS research on malleable cast iron as relates to the effect of melting conditions on metal behavior."

Prof. Heine, associate professor of metallurgical engineering, University of Wisconsin, has written more than 25 technical papers and is recognized widely for his investigational work.

WALTER R. JAESCHKE

"For substantial contributions to the development of cupola and air furnace melting of malleable iron, and to broader foundry knowledge of refractories."

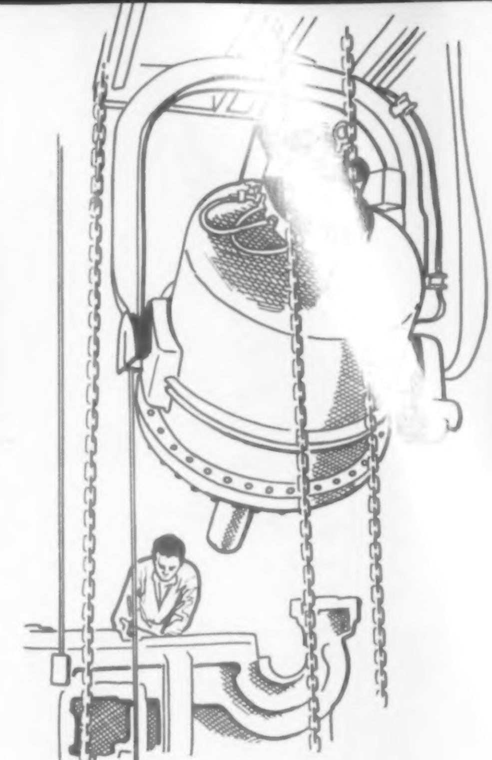
Mr. Jaeschke, consulting metallurgical engineer, Whiting Corp., Harvey, Ill., is an American authority on air furnaces, side-blow converters and duplexing.

ARTHUR E. SCHUH

"For conscientious effort in AFS cupola research investigations, and in development of the Society's basic ferrous publication, The Cupola and its Operation."

Dr. Schuh, director of research and development, United States Cast Iron Pipe Co., Burlington, N. J., holds several metallurgical patents and has written numerous articles.



CHARLES K. DONOHO
PETER L. SIMPSON GOLD MEDAL

"For outstanding contributions to the Society and to the ferrous casting industry, especially in the fields of gray iron, nodular iron and steel."
Mr. Donoho, chief metallurgist and technical director, American Cast Iron Pipe Co., Birmingham, Ala., has authored numerous technical papers on foundry technology.

CLYDE A. SANDERS
JOHN H. WHITING GOLD MEDAL

"For outstanding contributions to the Society and castings industry in the development and dissemination of fundamental data concerning the use of foundry molding sands."
Mr. Sanders, vice-president, American Colloid Co., Chicago, contributed heavily to sand practice and to foundry technology.

JOHANNES C. A. CRONING
JOHN A. PENTON GOLD MEDAL

"For his outstanding contribution to the foundry industry in the invention of the shell molding process for production of metal castings."
Mr. Croning, Croning & Co., Hamburg-Altona, Germany, has conducted broad research in the foundry field, and received the "International Award" in 1956.

GOLD MEDAL AWARDS

AFS SERVICE CITATIONS

AFS SERVICE CITATIONS . . "Intended exclusively as recognition for outstanding general service, not necessarily of a technical nature, to the Society and the castings industry."

THOMAS E. BARLOW

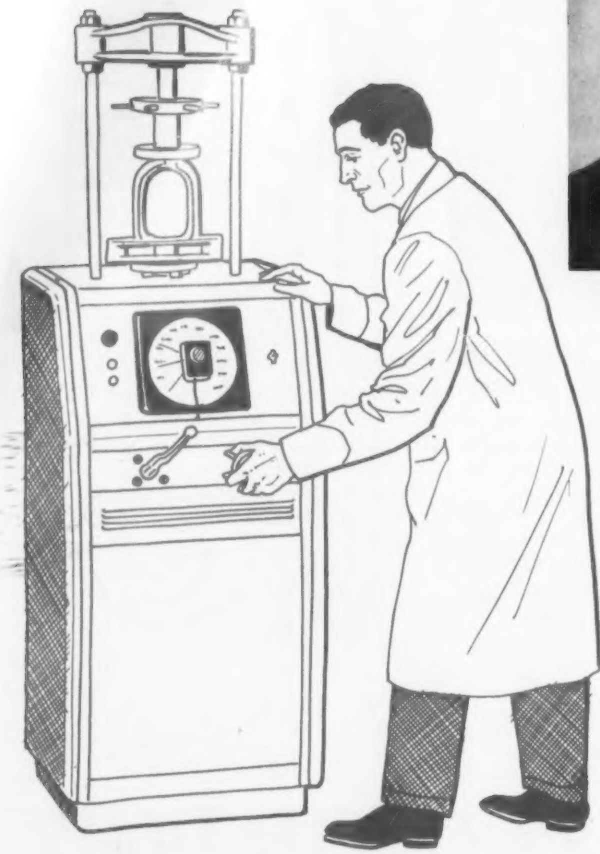
"For unstinting service to the Society and its Chapters as a speaker on molding sands, cupola operations and his willingness to serve."
Mr. Barlow, sales manager of Eastern Clay Products Dept. of International Minerals & Chemical Corp., Chicago has long served AFS on committees and as a speaker.
to foundry technology.

HORACE A. DEANE

"For conscientious service to the Society and the castings industry, especially in the encouragement of young men toward foundry work."
Mr. Deane, Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., has been active in setting up company programs and methods for developing foundry apprentices for supervisory capacities.

VINCENT DELPORT

"For distinguished service to the Society as its European representative, especially in connection with the International Foundry Congress."
Mr. Delport, Penton Publishing Co., London, England, has been continuously active in European foundry society activities for nearly forty years and has been European representative of AFS since 1926.



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B. G. Emmett, *Los Angeles Steel Casting Co.*
W. M. Hamilton, *Chattanooga Div., Crane Co.*
W. A. Morley, *Olney Foundry, Link-Belt Co.*
E. R. Oeschger, *General Electric Co.*
H. L. Ullrich, *Foundry Consultant*

TERMS EXPIRE 1958

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H. C. Erskine, *Aluminum Co. of America*
C. W. Gilchrist, *Cooper-Bessemer Corp.*
O. Jay Myers, *Archer-Daniels-Midland Co.*
C. E. Nelson, *Dow Chemical Co.*
R. A. Oster, *Beloit Vocational and Adult School*
R. W. Trimble, *Bethlehem Supply Co.*

TERMS EXPIRE 1959

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A. V. Martens, *Pekin Foundry & Manufacturing Co.*
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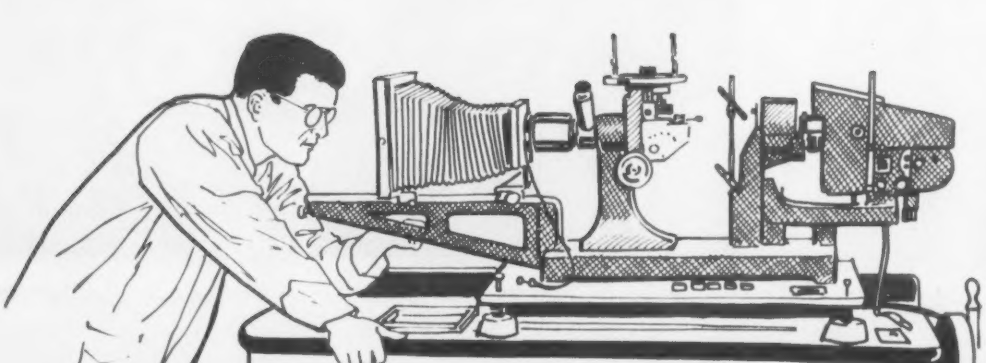

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HOSTS TO 61st AFS CASTINGS CONGRESS

E. H. King

R. J. Westendorf

E. J. James

The thousands of foundrymen who will soon converge on Cincinnati to attend the 61st AFS Castings Congress and 1st Engineered Castings Show will find that the AFS Cincinnati District Chapter has spread a welcome mat at the door to their great industrial city.

The chapter, under the direction of Chairman R. J. Westendorf, and its general convention committee, under Chairman E. H. King, have made many of the local arrangements for the Castings Congress.

Cincinnati District Chapter

Chairman—Richard J. Westendorf, Dayton Casting Co.
Vice-Chairman—E. J. James, Dayton Oil Co.
Secretary—Robert Thompson, H. P. Deuscher Co.
Treasurer—Arthur G. Jones, ARO Equipment Corp.
Co.

Roland Schwartz, H. Kramer and Co.

Plant Visitation Committee

Chairman—Martin E. Rollman, Cincinnati Milling Machine Co.
Vice-Chairman—Robert Thompson, H. P. Deuscher Co.
Vice-Chairman—Ernest J. Stockum, Dayton Malleable Iron Co.
Maurice G. Bolinger, Wm. Powell Co.
William Oberhelman, Oberhelman-Ritter Foundry
James Walther, Dayton Steel Casting Co.
Clifford Morningstar, Black Clawson Co.
Richard R. Deas, Jr., Hamilton Foundry & Machine Co.
William Schneble, Advance Foundry Co.

Shop Course Committee

Co-Chairman—J. S. Schumacher, Hill & Griffith Co.
Co-Chairman—William R. Oakley, Delhi Foundry Sand Co.
Helen L. Redmond, Buckeye Foundry Co.
Clyde McQuiston, Advance Foundry Co.
David Pusack, Cincinnati Milling Machine Co.
Eugene Brunsman, O.P.W. Corp.

Publicity Comittee

Chairman—Roland C. Schwartz, H.

Martin E. Rollman

J. S. Schumacher

and 1st ENGINEERED CASTINGS SHOW

Kramer and Co.
Charles Riese, Cincinnati Milling Machine Co.
E. J. James, Dayton Oil Co.

Banquet Committee

Chairman—E. J. James, Dayton Oil Co.
Vice-Chairman—Robert C. Shick, Ranson and Orr Co.
Treasurer—Arthur G. Jones, ARO Equipment Corp.
Maurice G. Bolinger, Wm. Powell Co.
Hartzel Bovard, Reliance Foundry Co.
William Dine, St. Mary's Foundry Co.
Richard R. Deas, Jr., Hamilton Foundry & Machine Co.
William Gilbert, Jr., Buckeye Foundry Co.
Milton E. Johnson, Whiting Corp.
Edward H. King, Hill and Griffith Co.
Charles T. Koehler, Hamilton Brass & Aluminum Casting Co.
William R. Oakley, Delhi Foundry Sand Co.
Richard A. Poirier, A. & B. Foundry Co.
Martin E. Rollman, Cincinnati Milling Machine Co.
Roland C. Schwartz, H. Kramer & Co.
E. J. Stockum, Dayton Malleable Iron Co., G. H. R. Foundry Division
Robert Thompson, H. P. Deuscher
Robert E. Webb, Tri-State Foundry Co.
Raymond L. Young, Peerless Foundry Co.

Reception Committee

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Arthur A. Alfers, Oakley Pattern & Foundry Co.
William Beiser, Reliance Foundry Co.
Ben Claffey, Dayton Malleable Iron Co., G. H. R. Foundry Division
Stephen F. Dana, Peerless Foundry Co.
Charles Erhard, Chris Erhart Foundry & Machine Co.
George Euskirchen, Jr., Cincinnati Foundry Co.
Herman Ewig, Cincinnati Milling Machine Co.
E. J. James, Dayton Oil Co.
Walter Klayer, Aluminum Industries
S. T. Korte, R. Lavin & Sons
R. J. Redmond, Buckeye Foundry Co.
Peter R. Rentschler, Hamilton Foundry & Machine Co.
Harold Ritter, Oberhelman-Ritter Foundry Co.
William Schneble, Advance Foundry Co.

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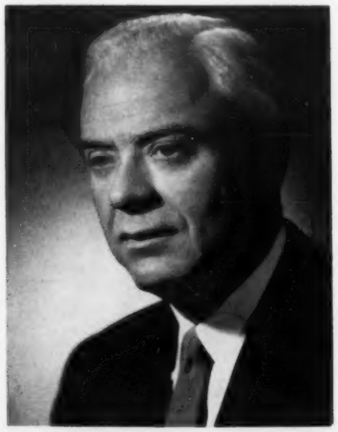

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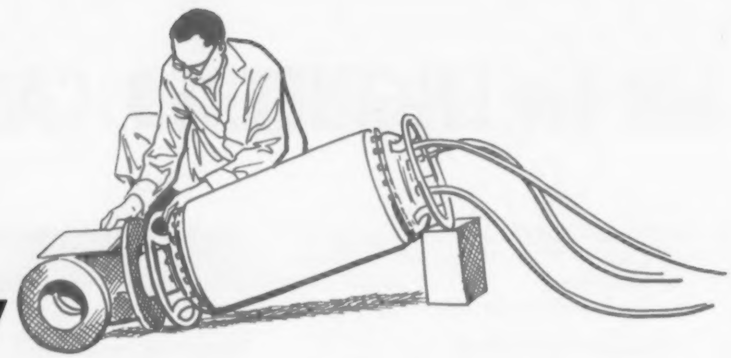

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CASTINGS

ENGINEERED FOR INDUSTRY

Five papers that will be presented at the 61st AFS Castings Congress have been preprinted in this bonus section. The five papers have been carefully selected as subjects that demonstrate the quality, utility, and economy of castings as solutions to design problems. The reader, foundryman or designer, will find in these articles new and basic information that may open the doors leading too the solution of his own particular problem. These are disclosures of advancements in cast metals technology that could be made only at the industry's important technical event, the Castings Congress of the American Foundrymen's Society.

- POWDERED GRAPHITE MOLDS SIMPLIFY TITANIUM CASTING
- HIGH PURITY ALUMINUM ALLOY SOLVES STRUCTURAL ENGINEERING PROBLEMS
- NEW CASTING ALLOY COMBINES HIGH STRENGTH AND CORROSION RESISTANCE
- VACUUM DIE CASTING OPENS NEW FRONTIERS IN DESIGN
- CASTING IN SAND TO EXCEED AIRCRAFT SPECS

A MODERN CASTINGS

BONUS

This section is the 22nd in a continuing series of special reports. Each of these sections is a handbook of practical and current information valuable to foundry management. Reprints are 50¢ each.

POWERED GRAPHITE MOLDS SIMPLIFY TITANIUM CASTING

Complex shapes can be cast in mixture easily formed into molds or cores with conventional equipment

A. L. Feild / *Metallurgist*
E. I. DuPont de Nemours & Co.
Wilmington, Dela.

R. E. Edelman / *Metallurgist*
Pitman-Dunn Laboratories
Frankford Arsenal, Philadelphia

Titanium base alloys are meeting some of the most severe demands required by the aircraft, chemical and marine industries. Low density, 40 per cent that of stainless steel and only 1.6 times that of aluminum, combined with tensile strengths as high as 140,000 psi in the as-cast condition, give titanium alloys the outstanding strength-weight ratio needed for airborne craft and missiles. Chemical processing plants and ships are using them for vital parts requiring top corrosion resistance.

The titanium casting industry has received a long needed assist by the development of a graphite powder molding material that can be formed into a mold or core using conventional pattern equipment. Molten titanium is difficult to cast because of its extreme reactivity with most refractory mold materials.

This reaction causes a severe embrittlement of the metal. Machined graphite molds have been found to be non-reactive but the machining costs are high; only certain shapes can be made this way; and the molds can be used only a few times before they spall and crack. In addition, the surface chill effect due to the high thermal conducticity of dense graphite makes

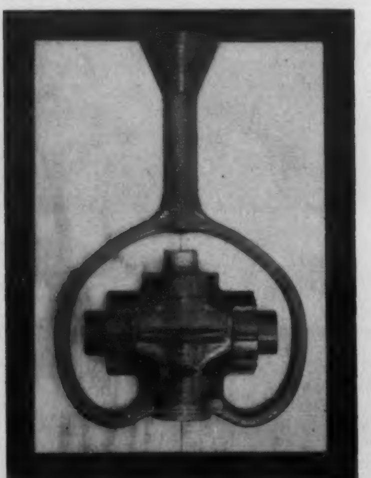

Fig. 1 . . Pattern has twin runner and bottom gate.

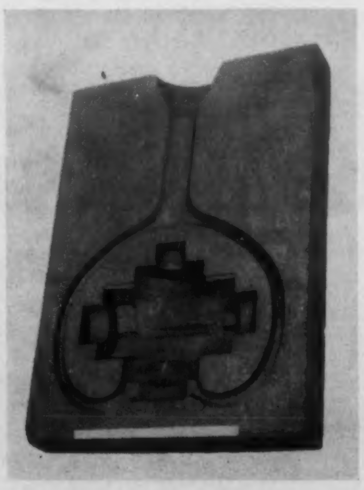

Fig. 2 . . Mold half made from wooden pattern.

Fig. 3 . . Finished mold half with core in position.

it virtually impossible to obtain a relatively smooth surface.

Water-cooled copper molds have also been used. Here again the expense, shape limitations, and chill factors are even further aggravated. Silica molds made by conventional foundry practices react badly with molten titanium. The castings are full of internal blow holes and possess extremely rough contaminated surfaces.[1]

Casting Problems

Shell molding techniques for producing non-reactive molds were investigated by Battelle Memorial Institute. Great improvement was noted using resin-bonded refractory oxides like zirconia, zircon, and alumina, which were specially coated with surface reaction inhibitors. Surface pinholes and internal porosity, however, were generally present in any sizeable section thickness[2,3,4,5,6]. Investment type casting methods also have been tried on titanium but with little or no success. Gross reaction occurs between the refractory oxides and binders used in these molds.

As calculated from thermodynamic considerations and observed in all experimental investigations, carbon (or graphite) is more inert to molten titanium than any other refractory material. Carbon absorption is not rapid in the liquid state and diffusion in the solid state even at elevated temperatures is extremely slow. The experience with machined graphite molds, where instantaneous surface solidification of molten metal on the mold wall occurs, has shown that uncontaminated castings can be produced.

The objects of this investigation were to (1) develop a mold composition based on graphite which would approach machined graphite in lack of reactivity, and at the same time be amenable to existing foundry mold preparation procedures; (2) cast a standard shape of titanium in molds of this composition using approved furnace techniques and thoroughly evaluate the properties of the castings thus produced; and (3) determine the course to follow for future development and commercial application.

Mold Fabricating

The processing of a new mold composition (U.S. patent applied for), based on the use of sized synthetic graphite powders bonded with suitable non-reactive agents, is briefly described here.

Screened synthetic graphite powders in the size range of −20 + 100 mesh are used as a base. The aggregate grain size approaches approximately an AFS 70 (gfn). This gives a fair degree of permeability in the finished mold and is not too difficult to bond in large shapes. The other mold constituents are dry cornstarch, pulverized pitch, carbonaceous cement, a surface-active agent and water. The optimum composition is as follows:

53 per cent electric furnace graphite powder (−20 + 100 mesh)
10 per cent dry cornstarch
10 per cent pulverized pitch
8 per cent carbonaceous cement
1 per cent surface activating agent
18 per cent water

Fig. 4 . . Finished graphite cores are permeable, hard, and take normal handling.

The starch is the "green" binder which facilitates room temperature molding and develops considerable green strength. Pitch and carbonaceous cement in combination form a solid high-temperature bond when the mold is fired. The use of either of these components alone results in rougher mold surfaces and reduced resistance to mold spalling. The surface active agent wets the graphite particles,

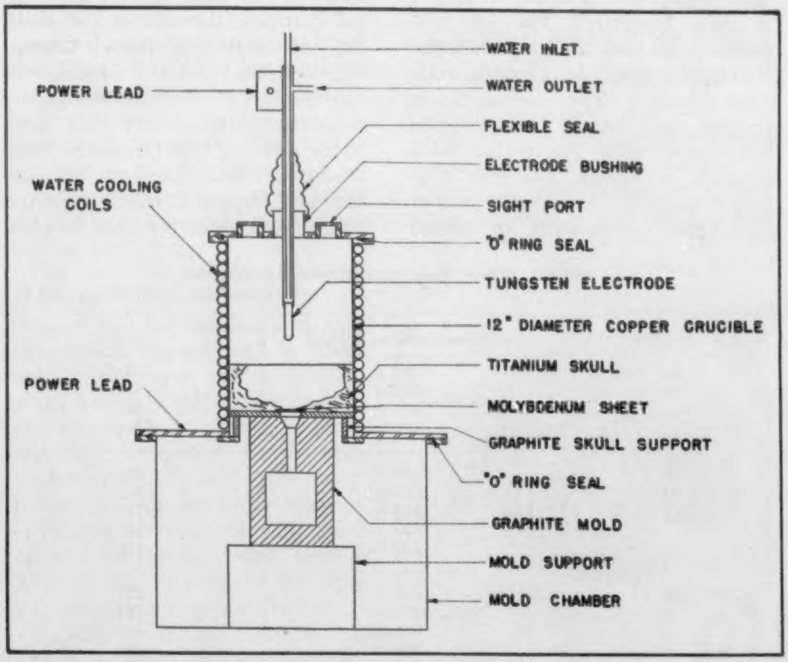

Fig. 5 . . Bottom-pour furnace utilizes a water-cooled copper crucible.

Fig. 6 . . Valve body after only a slight sand blast.

makes them compatible with starch and water, and reduces the amount of water necessary in the mixture.

All solid components except the graphite are essentially carbon compounds and are reduced to elemental carbon by firing. Thus a mold is produced which is free of oxygen and nitrogen bearing materials which could contaminate the metal.

Molding Method

Molds are made in a few steps with equipment readily available in most foundries. The graphite powders are dry blended with the starch and pitch in a commercial cone blender. The carbonaceous cement and surface active agent are mixed with the water in a separate container. The dry mixture is then transferred to a muller and liquid components are added slowly. After thorough mixing the damp mass is removed and dumped on wood or metal patterns which have been previously coated with a parting agent.

The mold and pattern box are then pressed using forces of 50-85 lb. per square inch of mixture contact surface. The mold is stripped from the pattern and dried at room temperature from 8 hours to 3 days depending on size.

Residual water is then baked from the mold in a drying oven with heat gradually increased from 140 F (60 C) to 248 F (120 C) over a period of 48 hours. Finally, the mold is fired in a reducing atmosphere furnace at 1292-1652 F (700-900 C) for 1-2 hours. After cooling, it is ready for use.

These molds are hard, permeable and can be handled without danger of breakage. A more complete explanation for the fabrication of these molds is given in a prior publication[7].

Step-shape titanium castings weighing from 1/2 to 7 lb. have been cast in molds of this composition without occurrence of significant reaction. High purity starting material (95 Bhn) retains its original hardness throughout the melting and casting operation. Chemical analyses indicate absence of contamination. Surface hardening is restricted to a very thin layer in the order of 0.020 in. deep. Yield strength, tensile strength, elongation and impact strength are comparable to values obtained in good wrought material of the same composition.

TABLE I. SURFACE MICROHARDNESS TRAVERSES

Base Hardness = 120 Khn = 105 Bhn

Location	Distance Below Surface	Khn
No. 1	.005 in.	281
	.010 in.	172
	.015 in.	128
	.020 in.	118
No. 2	.005 in.	206
	.010 in.	142
	.015 in.	132
	.020 in.	128
	.025 in.	120
No. 3	.005 in.	284
	.010 in.	184
	.015 in.	150
	.020 in.	136
	.025 in.	118

Casting a Valve Body

The purpose of this project was to cast in titanium a standard 1-1/2 in. plug-cock valve body—a common commercial item in cast iron, steel or bronze. To do this, a special pattern was constructed of mahogany and plywood, designed with a twin runner and bottom gates. The object was to fill the mold cavity rapidly. No top riser was employed and the first casting suffered some shrink in the upper sections. A top riser corrected this defect.

The pattern is shown in Fig. 1. The two mold halves produced from this one pattern are symmetrical about the vertical axis and may be placed together face-to-face to make a complete mold. A finished mold half is illustrated in Fig. 2. Note the internal core placed in one mold half, Fig. 3. This core was hand rammed in a core box using the same base composition as the mold itself. Fig. 4 shows a close view of a finished core.

Furnace Operation

The metal for the casting was (102 Bhn) titanium sponge melted in a bottom-pour vacuum arc-type skull furnace. Fig. 5 shows a schematic drawing of the bottom-pour furnace used to cast the titanium body. It consists essentially of a water-cooled copper crucible, a 1 in. diameter water-cooled tungsten-tipped electrode, an apparatus to supply an inert atmosphere having a ratio of 8 parts helium to 1 part argon, and a molybdendum sheet serving as a stopper.

A charge of 40 lb. of titanium sponge was loaded into the furnace. After 17½ minutes of arc melting, approximately 12 lb. of molten metal was poured. Different power settings were employed. The total kilowatt hours per pound of metal poured was 0.8. No additional pressure outside of the normal gravity feed was used, although an apparatus is available on the furnace to increase the pouring rate.

At the time of pouring, the pressure gages indicated no large pressure rises. This lack of an internal pressure increase is further indication of the lack of reaction between the molten titanium and the mold wall. A complete description of the furnace and its operation is given in the literature[8].

After casting in a cold mold, the mold was broken away from the cooled metal. The sprues, runners, and gates were sawed off and the core knocked out. With no other treatment than a slight sand blast the valve body appeared as in Fig. 6. None of the exterior surfaces displayed evidence of any metal-mold reaction. The slightly rippled appearance of the surface is due to insufficient superheat in the metal combined with the rapid chill effect of the high thermal conductivity mold.

TABLE II. CHEMICAL ANALYSES

	C	N	H	O	Bhn
Sponge	0.018	0.004	0.0014	0.069	102
Casting	0.018	0.005	0.0052	0.070	102

Additional Problems

Additional experimentation is planned in an effort to reduce the steep temperature gradient at the mold wall and yet avoid the prolonged contact of molten metal that permits carbon diffusion into the surface of the casting.

Of significant importance is the fact that no reaction of the metal with the core or internal surfaces was revealed, even at points of large section-size changes. This is a stringent test because the core is completely surrounded with molten metal and trapped gases and reaction products would have little chance to escape.

The use of a hollow collapsible core instead of a solid one would further reduce the chance of any surface contamination. Fig. 7 shows the solid cross section and lack of internal porosity of the walls. Etching of these wall surfaces reveals a uniform fine grain size throughout. Radiograph verified the absence of internal porosity.

The problem of adequately venting the molds when casting titanium must be recognized. Gas is easily trapped in a metal with such a relatively low density (4.54 g/cc) unless molds of high permeability are used. In this respect it is similar to aluminum (2.70 g/cc density) or magnesium (1.74 g/cc). The increasing use of consumable electrode melting furnaces, employing high vacuums instead of inert gas atmospheres, will certainly minimize the problem of gas entrapment. If gas comes from mold reaction, however, no advanced furnace engineering or change of mold design can cure the problem.

Tests And Analyses

Microhardness tests were made with a Tukon machine on sections of the casting for the purpose of determining the depth and degree of surface contamination. Table I presents three representative sets of Knoop hardness values which prove that the surface layer is shallow and not particularly hard. Base metal hardness is reached at a depth of approximately 0.020 in., but there is no detrimental contamination below approximately 0.010 in.

Several bend tests were made on specimens taken from the walls of one casting. In all the samples the bend was between 0 T and 1/2T, indicating extreme ductility in the cast metal. All the properties reported are on the cast material which was neither heat treated nor vacuum annealed.

The chemical analyses made on representative drillings conclusively show that uncontaminated castings may be produced in these molds with proper melting practices. In Table II the chemical composition of the starting sponge material is compared with the composition of the cast valve body. There is no absorption of unwanted interstitial elements. The small increase in the hydrogen level is the only consequence of the melting and casting operation.

Castings may be subjected to some type of machining operation such as facing flanges, cutting threads or machining interiors to tolerance. To demonstrate the ability of these castings to be satisfactorily machined, threads were cut in one valve body on a lathe using a high-speed steel tool. The threaded casting openings of 1-1/2 in. IPS and 2 in. IPS size are shown in Fig. 8. No difficulty was encountered in this operation and no internal voids were revealed.

Hydrostatic Test

A hydrostatic test was conducted on this casting for the purpose of determining pressure tightness. The threaded openings of the casting were sealed by insertion of appropriate carbon steel pipe plugs. Water was introduced through a special fitting in one of the plugs. At a pressure of 300 psi, the test was stopped because of a faulty plug connection. The casting showed no leaking at this pressure.

Although this work has been conducted on a limited scale it has served to demonstrate conclusively that titanium can be cast into desired shapes provided a satisfactory mold material is used. Much remains to be done before this process, or further modifications of it, can be expanded into a commercial production scale in the foundry.

Two Further Problems

Two significant problems concerning the mold material still need systematic investigation. One is the amount of water necessary to produce a mixture which can be properly rammed or pressed. The surface-active agent used has helped

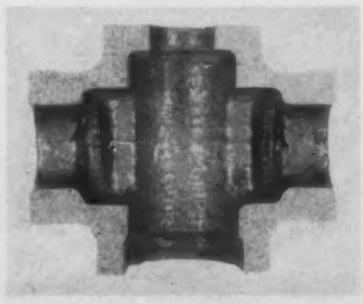

Fig. 7 . . Cross section shows lack of internal porosity.

Fig. 8 . . Machining operations are done by usual methods.

to reduce necessary water considerably. But further reduction to the level of perhaps 6-8 per cent is desirable to obviate mold cracking problems during drying.

Also, the proper blends of particle sizes and their distribution in the mold aggregate is extremely important. Better equipment for mixing and blending would undoubtedly reduce the amount of both the binder and the liquid vehicle necessary.

The other problem concerns the proper control of mold thermal conductivity or mold temperature to permit castings with smooth walls to be produced. The extremely rapid chill of the present molds with large percentages of graphite produces a rippled casting surface. In addition, with present type melting furnaces, sufficient superheat is difficult to obtain in the molten charge.

One way to reduce the cooling rate of the metal would involve preheating of the molds before casting to decrease the temperature gradient between molten metal and mold wall. This conductivity aspect may have to be closely controlled, however, to prevent molten metal contamination by excessive contact with the mold wall.

Summary

This work demonstrates that shaped unalloyed titanium castings can be produced without contamination in a newly developed expendable graphite powder mold made by ordinary foundry techniques. Careful tests show the castings to have neither surface pinholes nor internal porosity due to reaction with the mold.

Chemical analyses reveal the cast metal to be essentially of the same purity as the original charged material. Mechanical tests illustrate excellent ductility and machinability. The surface hardened layer does not exceed a depth of 0.020 in. nor a hardness of 300 Khn. The use of internal cores presents no reaction or knockout problems.

The mold material shows great promise but further development is needed to eliminate processing problems associated with the high water content. Also, the surface finish of castings made in these molds must be improved to eliminate wrinkles caused by too rapid a chill. Mold preheat, greater metal superheat, and modification of the composition are some of the possible solutions that meant further investigation.

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This article is the preprint of "*The Use of Expendable Graphitic Molds in the Production of Sound, Ductile Titanium Castings,*" which will be presented at a Light Metals session of the 1957 AFS Castings Congress and Engineered Castings Show in Cincinnati May 6-10.

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Chicago

Higher aging temperatures ductility and strength raise alloy's stress-resisting qualities

Aluminum alloy 356 is used extensively for aircraft fittings and pump parts and automotive cylinder blocks and transmission parts. This alloy has excellent castability producing pressure tight castings with good corrosion resistance. By improved practices described here, alloy 356 tensile strength can be raised from 35,000 to 47,500 psi thereby extending its structural applications beyond its present limitations.

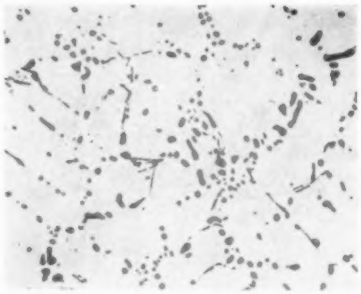

Fig. 1a . . Beta iron-silicon constituent in 356 standard.

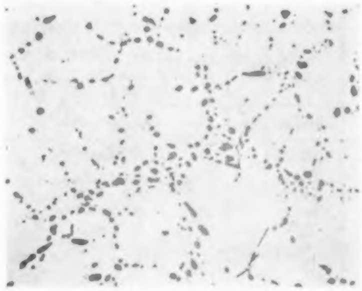

Fig. 1b . . Beta iron-silicon constituent in HP 356 alloy.

Remarkably improved physical properties for aluminum alloy 356 have been obtained by limiting the iron content to a maximum of 0.15 per cent.

This improvement is a welcome one for design engineers who for many years have sought an aluminum casting alloy that would perform satisfactorily under applied stresses such as those produced in structural parts for aircraft, automotive, and industrial equipment. The demand for higher quality by these industries has required foundrymen to produce exceptionally sound castings incorporating high strength and ductility. In addition to high strength and ductility, casting alloys must display castability, machineability, dimensional stability, and corrosion resistance.

The alloy which approaches these characteristics almost in entirety is alloy 356 of the aluminum-

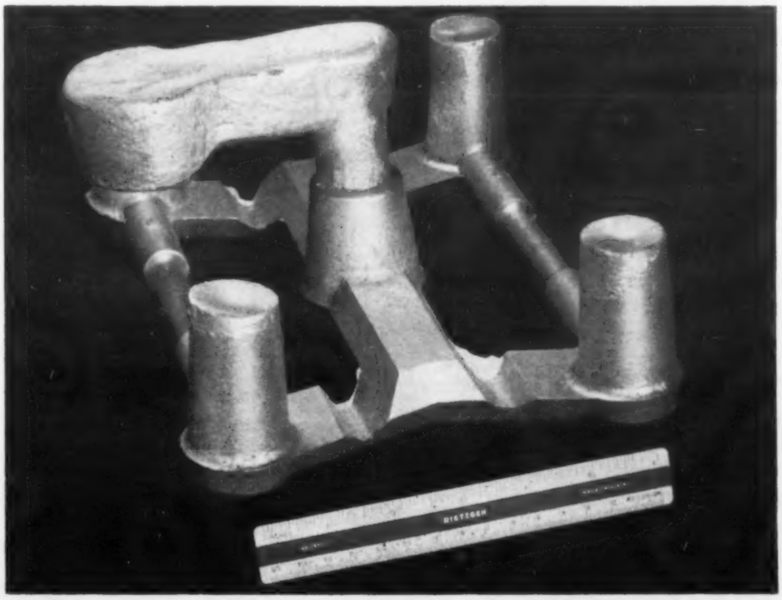

Fig. 2 . . Sand cast test bars were made in natural bonded green sand

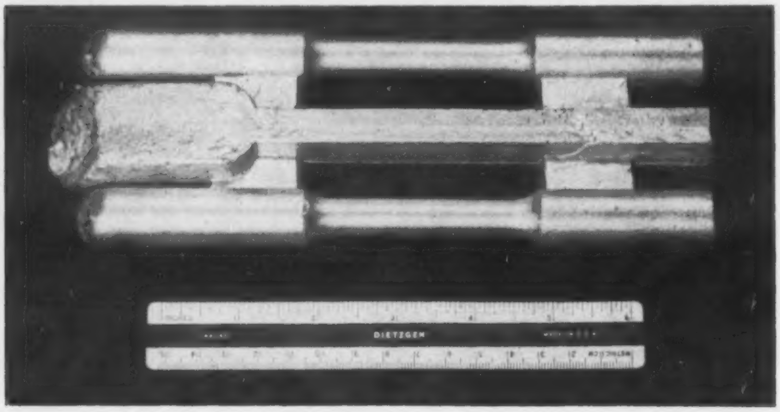

Fig. 3 . . Operating temperature of 625 F was used for permanent mold when casting test bars. Metal poured between 1250-1300 F.

TABLE I. HP 356 ALLOY SPECIFICATION AND ANALYSIS VERSUS STANDARD GRADE

Element	HP 356 Specification	Typical Analysis	
		HP 356	Std. 356
Cu	0.10 max	0.01	0.08
Si	6.5 - 7.5	7.00	7.00
Fe	0.15 max	0.11	0.40
Mg	0.25 - 0.40	0.34	0.32
Zn	0.10 max	0.02	0.03
Mn	0.10 max	—	0.01
Ti	0.20 max	0.11	0.10
Other elements each	0.03 max		
Other elements total	0.10 max		

silicon-magnesium group. This popular foundry alloy produced with a low impurity content, particularly iron, exhibits exceptionally high ductility.

Effect of Iron

The unique factor which makes alloy HP (high purity) 356 superior is its much greater reserve of ductility. This is accomplished by limiting the iron content to a maximum of 0.15 per cent and holding other impurities to as low a value as possible. The effects of minor alloying elements and impurities on alloy 356 have adequately been covered in the paper by Lemon and Hunsicker[1]. However, since iron, above all other impurities, has such a detrimental effect on the ductility of alloy 356, photomicrographs exhibiting a comparison between the beta iron-silicon constituent of HP 356 and standard 356 is shown in Fig. 1. According to Mondolfo[2] and Bonsack[3], beta iron-silicon occurs in the form of large thin needles and plates. Like most intermetallic compounds, it is brittle and reduces ductility, in proportion to the amount present. The specification for alloy HP 356 is given in Table I, along with a typical chemical analysis compared with the standard grade.

Heat Treatment

The higher ductility of HP 356 permits the use of more complete artificial aging in order to develop the full potential strength values without approaching brittleness not possible to accomplish with ordinary standard grades. While it is not ordinarily thought of in this manner, the T6 heat treatment actually was designed to permit only partial aging in an effort to conserve elongation at the expense of strength. Now, however, with the high purity version, heat treatments can be used which develop the full strength potential without the elongation deteriorating drastically.

Standard solution heat treatment practices are not changed for alloy

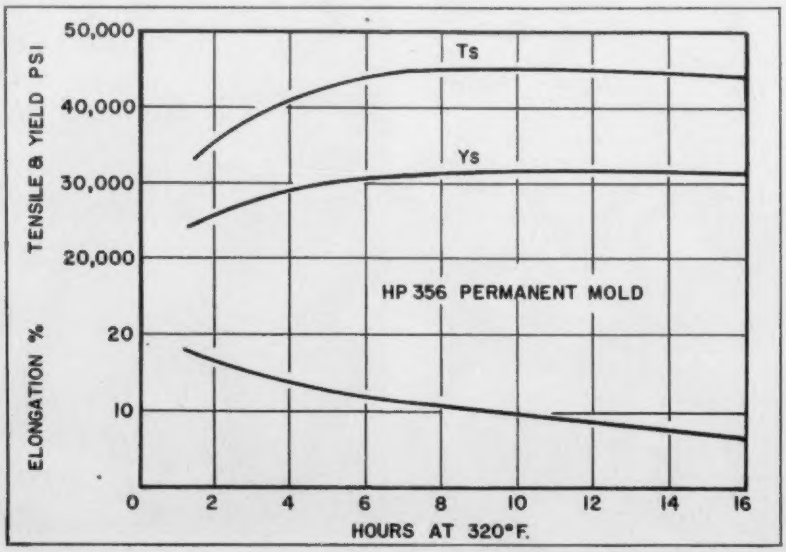

Fig. 4 . . Aging curves of alloy HP 356, permanent mold, at 320 F.

HP 356. Combinations of properties are obtained by varying the aging temperatures and time at temperatures. Thus, mechanical properties can be obtained in a range from 41,000 psi tensile strength, 23,000 psi yield strength, 16 per cent elongation to 45,000 psi tensile strength, 34,000 psi yield strength, 8 per cent elongation for permanent mold, and from 37,000 psi tensile strength, 25,000 psi yield strength, 10 per cent elongation to 41,000 psi tensile strength, 34,000 psi yield strength, 5 per cent elongation for sand cast.

Experimental Procedure

All alloy ingot was melted in a propane gas-fired furnace, using silicon carbide-clay bonded crucible, with sodium borate glaze. Approximately 50 pounds of aluminum were melted at one time. Fluxing was accomplished by flushing with chlorine gas for approximately five minutes. Casting temperatures for both sand cast and permanent mold castings were between 1250 F (677 C) and 1300 F (705 C). The operating temperature of the permanent mold was approximately 625 F (330 C). Sand cast test specimens were cast in natural bonded green molding sand.

To determine the effect of a higher magnesium content on alloy HP 356, an addition calculated to 0.60 per cent magnesium was made using pure stick magnesium. This high-magnesium alloy is designated XHP356. The material was plunged below the surface of the melt and stirred in to insure uniformity in composition.

Standard test bar designs were used for both sand and permanent mold test specimens as shown in Fig. 2 and 3. All test specimens were radiographed to insure casting soundness. The quality was judged by radiographing the original specimens from two mutually perpendicular directions which were also perpendicular to the major axis of the specimen and by inspection of the fractured surfaces of the specimens. This judging was done without regard to the tensile results.

Established melting and casting techniques were followed throughout this investigation.

Table II lists the chemical analysis of the alloys involved in this investigation. All chemistry was determined by wet chemical means on chill cast discs.

Solution heat treatment was performed in a circulating hot air furnace. The specimens were held at a temperature of 1000 F (538 C)

TABLE II. CHEMICAL ANALYSIS OF ALLOYS HP 356 AND XHP 356

Alloy	Composition (Percentage)					
	Cu	Si	Fe	Mg	Zn	Ti
HP 356	0.01	6.9	0.12	0.31	0.01	0.10
XHP 356	0.01	6.9	0.10	0.58	0.01	0.09

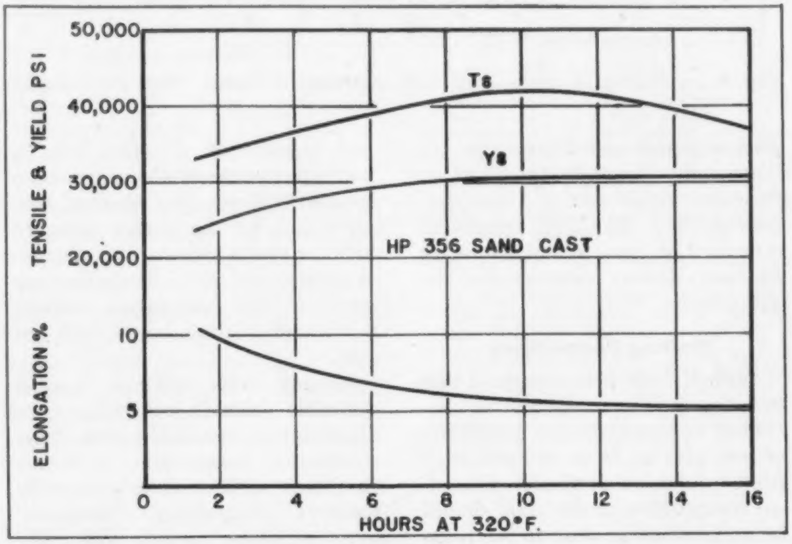

Fig. 5 . . Alloy HP 356 gives a broader combination of mechanical properties at temperatures of 320 F than shown by alloy XHP 356.

TABLE III. AVERAGE PERMANENT MOLD MECHANICAL PROPERTIES OF ALLOYS HP 356 AND XHP 356 AS COMPARED WITH STANDARD 356

Temp. (F)	Hours at temp.	Alloy	Typical Values (not guaranteed) Tensile Strength (psi)	Tensile yield strength* (psi)	Elongation (% in 2 inches)
350	2	Std 356	38,500	31,500	7.0
	8		40,100	35,000	3.0
	2	HP 356	39,200	30,000	9.0
	8		41,500	31,000	7.0
	2	XHP 356	46,000	36,500	6.2
	8		49,500	44,000	1.8
375	2	Std 356	40,200	33,500	6.0
	8		36,000	32,500	2.5
	2	HP 356	42,500	32,000	11.0
	8		37,500	30,000	11.0
	2	XHP 356	46,000	40,000	3.0
	8		43,500	37,000	12.5
400	2	Std 356	40,000	32,500	8.0
	8		38,000	30,500	5.5
	2	HP 356	40,500	32,500	10.0
	8		35,500	26,500	12.0
	2	XHP 356	46,000	40,500	8.2
	8		40,500	34,000	6.0
425	2	Std 356	40,000	32,500	6.2
	8		32,000	23,000	11.5
	2		37,500	29,000	11.0
	8	HP 356	29,500	19,500	14.0
				* offset = 0.2%	

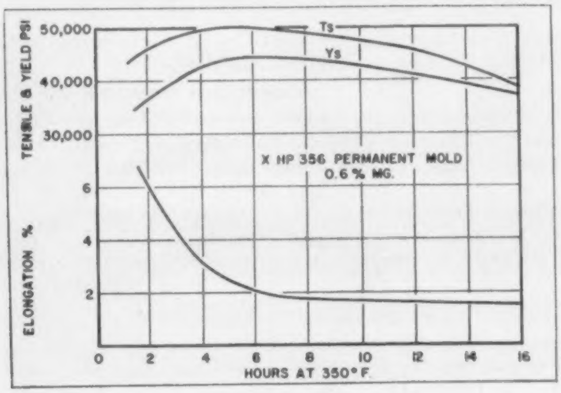

Fig. 6 . . Aging of alloy XHP 356, permanent mold.

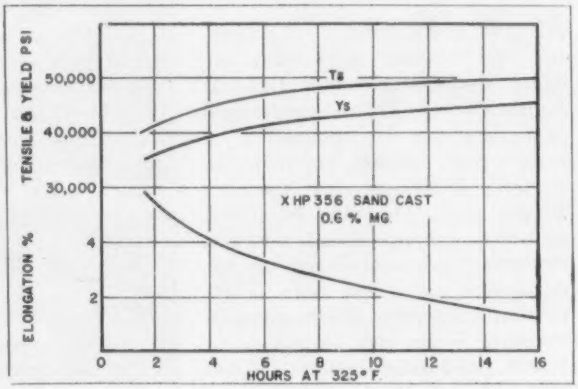

Fig. 7 . . Aging curves of alloy XHP 356, sand cast.

plus or minus two degrees, for ten hours and were then quenched into water which was at a temperature of 180 F (82 C). All specimens remained at room temperature for 24 hours before commencing the aging cycle.

Melting Precautions

With HP 356 it is important that foundry melting practices be controlled to eliminate the possibility of iron pick up from equipment or from foreign contaminates. Chemical composition of the alloy should be maintained as close to the nominal amount as possible. This is particularly true of the magnesium content 0.30 per cent nominal. Observations by the author seem to indicate that a significant reduction in tensile and yield properties can result if the magnesium content is allowed to drop below 0.25 per cent.

Fluxing with chlorine gas is desirable although it does have one disadvantage associated with alloys containing magnesium. Chlorine combines with, and subsequently removes magnesium. However, most suppliers furnish this alloy with magnesium near the high side so that the nominal composition is reached after remelting and fluxing. HP 356 has excellent casting characteristics, machinability, dimensional stability, and corrosion resistance.

Aging Procedures

Aging curves for alloys HP 356 and XHP 356 sand and permanent mold cast are shown in Fig. 4, 5, 6 and 7. An examination of these curves seems to indicate that a generous combination of mechanical properties is available for the 320 F (160 C) temperature for alloy HP 356. The range is somewhat narrower for alloy XHP 356. Higher aging temperatures, particularly for permanent mold, were necessary to develop optimum mechanical properties for alloy XHP 356.

Several different aging temperatures were investigated for both alloys. Some of the mechanical properties obtained for permanent mold and sand cast are shown in Tables III and IV compared with the standard grade of alloy 356. Close examination of these two tables gives some indication of the wide latitude of properties available at the temperatures indicated. A striking increase in properties for alloy HP 356 is readily apparent, particularly yield strength and elongation, when compared against those of the standard 356 shown in the tables.

It is apparent that greater ductility is available in the Al-Si-Mg

TABLE IV. AVERAGE SAND CAST MECHANICAL PROPERTIES OF ALLOYS HP 356 AND XHP 356 AS COMPARED WITH STANDARD 356

Temp (F)	Hours at temp.	Alloy	Typical Values (not guaranteed) Tensile strength (psi)	Tensile yield strength* (psi)	Elongation (% in 2 inches)
350	2	Std 356	35,000	27,500	5.0
	8		38,000	32,000	2.5
	2	HP 356	39,500	30,000	7.5
	8		40,000	33,000	5.0
	2	XHP 356	47,500	41,500	2.5
	8		46,000	43,000	1.8
375	2	Std 356	36,500	30,000	3.5
	8		34,000	30,000	2.5
	2	HP 356	40,000	32,000	6.5
	8		39,000	34,000	5.0
	2	XHP 356	47,500	45,500	2.0
	8		45,000	42,000	1.5
400	2	Std 356	36,200	29,000	3.5
	8		32,500	25,000	4.0
	2	HP 356	40,500	33,000	8.0
	8		35,500	27,500	6.2
	2	XHP 356	47,500	45,500	2.0
	8		42,500	39,000	2.5
425	2	Std 356	34,500	26,800	5.0
	8		29,000	20,000	5.0
	2	HP 356	37,700	30,000	7.0
	8		31,500	22,500	12.5
				* offset = 0.2%	

alloy 356 when the iron content is maintained at as low a level of concentration as possible.

A 24 hour holding period after the solution heat treatment is definitely advantageous. According to Quad[4], cast alloys utilizing magnesium silicide as the principal hardening compound are markedly affected by a room temperature aging interval. The direct effect of this interval is an increase in ductility.

Utilizing the data and aging curves in the text should enable a design engineer to pick a combination of properties suitable for his requirements.

Properties Developed

Alloy XHP 356 developed some interesting properties and where high strength and high hardness with fair ductility is required, this alloy may offer some advantage. The higher combination of yield strength and elongation obtainable with HP 356 should result in substantially higher impact strength.

It is apparent that higher aging temperatures are necessary to develop properties for HP 356 and XHP 356. The aging temperatures of 320 F (160 C), Fig. 4 and 5, were not chosen to indicate this temperature as producing the best properties. These curves were plotted to show the variation in properties that are available at one aging temperature. Specific tempers, for example T6, can be picked from Tables III and IV.

TABLE V. SUGGESTED AGING CYCLES FOR ALLOY HP 356

Temper	Time, hours	Temp. (F)	Remarks
T6	3	320	Permanent Mold
T61	8	320	Permanent Mold
T6	2	350	Sand Cast
T61	2 - 4	400	Sand Cast

Conclusions

Alloy HP 356 exhibits superior ductility and improved tensile and yield strengths. The alloy should find wide acceptance for applications involving stressed parts. The variety of properties is only limited by the preference of the design engineer. Table V lists some suggested aging cycles for sand cast and permanent mold castings.

Alloy XHP 356 with a nominal composition of 0.60 per cent magnesium aged four hours at 350 F (177 C) permanent mold, and six hours at 325 F (163 C) sand cast, will produce mechanical properties of unusually high strengths with comparatively fair ductility.

Acknowledgment

The author wishes to express his appreciation to the Division of Metallurgical Research, Kaiser Aluminum & Chemical Corporation, Spokane, Washington, and especially to Alan T. Taylor of that division for compilation of the data.

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This article is the preprint of a paper entitled "*Aging Practices for High Strength Ductile Aluminum Alloy HP 356*," which will be presented at a Light Metals session of the 1957 AFS Castings Congress and Engineered Castings Show in Cincinnati, May 6-10.

NEW CASTING ALLOY COMBINES HIGH STRENGTH and CORROSION RESISTANCE

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New cupro-nickel alloy is designed for service in marine and power installations

Often the developments taking place in wrought alloys point the way to improved casting alloys. The excellent service life obtained from 90-10 wrought cupro-nickel alloys modified with iron and manganese led to this development of similar type casting alloys. Larger seagoing ships moving at faster speeds have required increased erosion and corrosion resistant castings. Ships and power plants find this new alloy meets their needs.

To meet the severe requirements of marine service a cupro-nickel casting alloy has been developed with a tensile strength of 95,000 psi. This copper-base alloy contains 12 per cent nickel, 1.5 per cent aluminum, 1 per cent manganese, 0.6 per cent iron, and is deoxidized with 0.05 per cent each of phosphorous, titanium, and calcium.

In developing a casting alloy for the specific purpose of marine serv ice the following objectives were considered: (1) suitability, (2) cost, (3) castability and pressure tightness, (4) strength and ductility, (5) weldability and (6) appearance. Since it was known that the cupronickels containing iron were suitable and of agreeable cost it was only necessary to develop them to fit the remaining four objectives.

The tremendous amount of work that covered alloying, finishing and testing of a long list of compositions resulted in the acceptance of the 90-10 cupro-nickel alloys modified with iron and manganese as being very satisfactory for sea water service. This was found not only by laboratory tests but by actual service tests in power stations and on shipboard.

However the commonly accepted cast fittings were no match for these new tube alloys. A suitable casting alloy was needed for making fittings. This alloy needed to have a sea water corrosion and erosion resistance equal to or better than that of the wrought 90-10 alloys. Cast alloys having a better resistance to erosion corrosion than the wrought alloys would be most desirable since most fittings are points of turbulence. They would, therefore, have to withstand impingement attack along with the general corrosion encountered.

Experimental Procedure

In order not to introduce too many variables at one time, a base of 12 per cent nickel was selected. A series of 30 pound induction furnace melts were designed to explore the various levels of iron, manganese and deoxidizers needed to give equal or better properties than the older accepted alloys that were giving relatively short service lives as fittings.

Mechanical properties, along with the fracture and pressure characteristics, of a bushing casting from each melt were used as the criteria for judging the melting and molding qualities obtained.

Tensile bars were cast to shape in green sand using the Eash four-bar pattern that produces 3/4 in. diameter reduced section bars, cast horizontally. These bars form a square with a 1-3/4 in. diameter riser at each corner. A down sprue in the center is connected by 3/8 x 3/4 in. gates to the risers. Photo-

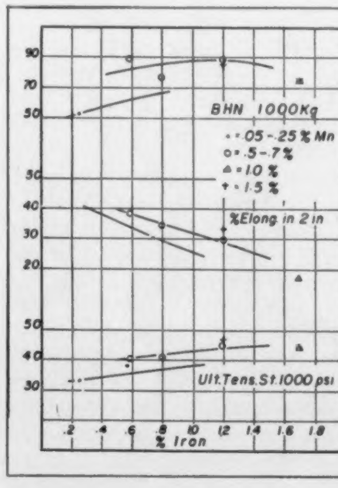

Fig. 1 . . Influence of iron.

graphs of castings from this pattern have been set forth in AFS TRANSACTIONS, v 46, (1938) page 43. Bushings, measuring 2-1/2 OD x 3/8 wall x 4 in. long made with a dry sand core, were cast from each of the melts to check pressure tightness.

Melting was done in unlined clay-graphite crucibles in a 30 lb. high-frequency induction furnace, and later in a 175 to 400 lb. oil-fired crucible furnace.

Iron and Manganese

The effects of iron and manganese on the tensile properties are shown in Fig. 1 and Table I. Low iron and low manganese combined produced somewhat lower than desired strengths. With greater additions of manganese the strength could be increased to above 40,000 psi, with elongations in the 35 to 40 per cent range. It is evident from this figure that about 1.2 per cent iron is necessary to produce a tensile strength of 45,000 psi. Higher iron was found to be somewhat detrimental to ductility.

Manganese has a mild hardening effect and a minimum of about 0.65 per cent should be added. Greater amounts up to 1.5 per cent had little influence on the tensile properties. But it is believed that manganese helps retain the iron in solution, which is desirable, so a level of 1.0 per cent was calculated in the later heats. Bailey[1] has found that the sea water corrosion resistance of the iron-containing wrought cupro-nickel alloys was adversely affected by the presence of an undissolved iron-rich second phase.

With some of the higher iron and manganese melts, trouble was encountered with a few leaky bushings. These exhibited some porosity and a dark discoloration in the fracture, indicating that phosphorus alone was not giving sufficient deoxidation to overcome the slight day to day variations in the moisture content of the sand molds.

TABLE I. TYPICAL MECHANICAL PROPERTIES OF THE 90-10 CUPRO-NICKEL ALLOYS WITH IRON

Composition — (per cent) (1)							Ultimate Tensile Strength (psi)	Yield Strength 0.5% Extension (psi)	Per cent Elongation in 2 in.	Bhn 1000 Kg
Cu	Ni	Fe	Mn	Si	P	Other				
Effects of Iron										
Bal.	12.01	0.74	(1.0)	—	(0.08)		34600	13400	31	63
"	(12.0)	(1.7)	(1.0)	—	(0.08)		44500	23000	18	76
Effects of Manganese :										
Bal.	12.03	1.20	0.69	—	(0.08)		45500	21500	30	90
"	12.0	1.22	1.43	—	(0.08)		48800	26600	21	108
Effects of Phosphorus										
Bal.	(12.0)	(1.2)	(1.0)	—	(0.08)		45500	21500	30	90
"	(12.0)	(1.2)	(1.0)	—	(0.15)		45500	30100	8	100
Effects of Silicon										
Bal.	11.72	1.07	0.97	0.043	—		40100	15300	42	72
"	(12.0)	(1.2)	(1.0)	(0.1)	—		47500	23600	29	90
"	(12.0)	(1.2)	(1.0)	(0.2)	—		31900	30000	3	128
(2) Bal.	(12.0)	(1.2)	(1.0)	(0.1)	—		47200	24750	34	100
Effects of Nickel										
Bal.	(5.0)	(1.2)	(1.0)	(0.1)	—		31000	13400	42	61
"	(8.0)	(1.2)	(1.0)	(0.1)	—		37500	15100	40	70
"	(12.0)	(1.2)	(1.0)	(0.1)	—		47400	24000	30	90
Effect of Charcoal Cover										
Bal.	(8.0)	(1.2)	(1.0)	(0.1)	—		43100	21200	37	76
"	(12.0)	(1.2)	(1.0)	(0.1)	—		55800	32500	28	108
Effect of Lead										
Bal.	(12.0)	(1.2)	(1.0)	(0.1)	(0.03)	Pb (0.25)	40800	17700	19	98

Notes: (1) Numbers in parentheses indicate added percentages, all others indicate data from analysis.
(2) 250 lb. crucible melt, dry sand molds. Others green synthetic sand.

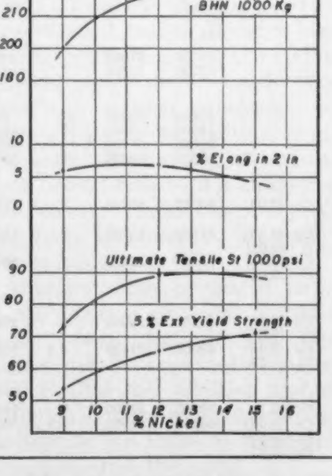

Fig. 2 . . Effects of nickel.

Deoxidation

A number of known deoxidizers were run on a 12 per cent nickel, 1.2 per cent iron and 1.0 per cent manganese base in order to determine the most potent deoxidizer for the composition, consistent with high strength and pressure tightness. This list included, magnesium, aluminum, titanium, barium, lithium, zinc and silicon. Silicon metal at 0.10 per cent was the most effective. The upper limit that can be tolerated safely is about 0.15 per cent. It was found that 0.20 per cent seriously decreased the ductility to 3 per cent and produced leaky pressure bushings.

By using a small amount of phosphorus (0.03 to 0.05 per cent) with about 0.10 per cent silicon the strength properties can be increased by about 10 to 12 per cent with a small loss in ductility, but still retain pressure tightness. A charcoal cover will also give slightly higher properties along with somewhat closer control.

After establishing a base with 1.2 per cent iron and 1.0 per cent manganese and using the silicon deoxidation, a short nickel series was investigated. As shown in Fig. 2, the 5 per cent alloy did not develop sufficient strength to be of interest while the 8 per cent alloy falls near 40,000 psi. Ten to thirteen per cent nickel appeared to be a more satisfactory operating range.

Aluminum Added

Some of the data collected on the corrosion of tube alloys showed that aluminum might be of assistance in combating erosion and impingement attack. A series of these

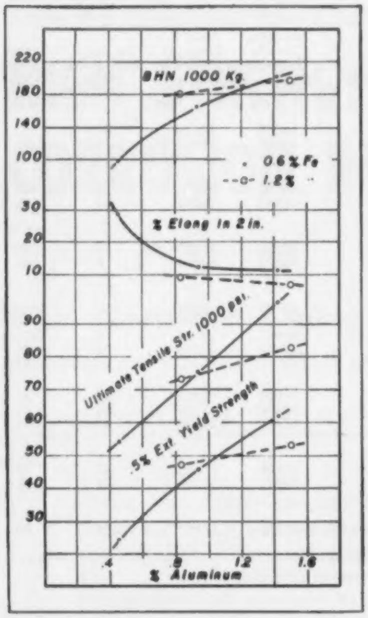

Fig. 3 . . Aluminum strengthens.

melts was made containing from 0.5 to 1.75 per cent aluminum with the rather surprising results shown in Fig. 3. An almost linear advance in tensile strength was gained by increasing the amount of aluminum.

After some experimentation with the iron and manganese contents, optimum properties were obtained for this 12 per cent nickel alloy at about 0.6 per cent iron, 1.0 per cent manganese, and 1.5 per cent aluminum. The as-cast strength was found to be 96-98,000 psi with an elongation of about 11 per cent. Higher iron again was found to lower the ductility somewhat. The high strengths and hardnesses found in these alloys are believed to be due to the precipitation of a high nickel-aluminum compound during the slow cooling of the castings.

A variable nickel series was made and examined in these 1.5 per cent aluminum-containing alloys with the results shown in Fig. 4, and Table II. The 9.0 per cent nickel alloy developed over 70,000 psi ultimate strength but the maximum of about 90,000 psi was reached at around 12 per cent nickel.

Evidence indicates that with a suitable adjustment of the aluminum content and deoxidation at the higher nickel levels somewhat higher strengths may be obtained. The lower elongations noted in Fig. 4 as compared to Fig. 3 are the result of a series of melts made with a multiple deoxidation that was developed in trying to combat the obnoxious habit aluminum has for forming oxide films. Some ductility was sacrificed for increased pressure tightness.

This multiple deoxidation was the outcome of a series of deoxidation trials made toward improving the pressure tightness of these aluminum-containing alloys. Phosphorus alone had not proven potent enough to insure pressure tightness in the hydraulic-type castings although the tensile castings were satisfactory. Silicon alone would insure about 30 per cent pressure tightness but there was still some filming tendency. Finally a combination of phosphorus, titanium and calcium-silicide in amounts of 0.05 per cent each was settled on as producing more pressure tight castings than any other combination of deoxidizers tried.

The effects of various impurities were studied. Several of the deoxidizers themselves seriously impaired the properties if used to excess. High phosphorus (0.15 per cent) was found to lower the ductility seriously. Where fabrication or assembly of castings by welding is expected, phosphorus should be omitted from the deoxidation procedure since it has been found to cause weld cracking. Silicon should be held below the embrittling range, preferably not over 0.15 per cent. Silicon can be used in the weldable castings to replace the phosphorus.

Lead was found to be deleterious to these alloys in all amounts exceeding 0.1 per cent. Mechanical properties were lowered 15 to 30 per cent by additions of 0.1 and 0.25 per cent.

Therefore lead should be kept out of these alloys. Examples of the above described effects are shown in Table I and II.

Recommended Practice

Melting. These alloys are best produced by melting down the copper and nickel, at about 2320 F, deoxidizing with 0.03 per cent of 14 per cent phosphor-copper, adding the iron and manganese, either as high purity pig iron and 97 per cent manganese metal, or as ferro-

TABLE II. TYPICAL MECHANICAL PROPERTIES OF THE 90-10 CUPRO-NICKEL ALLOYS WITH ALUMINUM

Composition—(per cent) (1)								Ultimate Tensile Strength (psi)	Yield Strength 0.5% Extension psi	Per Cent Elongation in 2 in.	Bhn 1000 Kg
Cu	Ni	Fe	Mn	Al	Si	P	Other				
Effect of Iron and Manganese											
86.06	11.80	0.21	0.50	1.40	—	(0.08)		79500	51000	9	170
Bal.	(12.0)	(1.2)	(1.0)	(1.5)	—	(0.08)		82250	52700	7	196
Effect of Aluminum with Phos. Deoxidation											
86.03	11.93	0.57	0.91	0.45	—	(0.08)		53800	23800	28	98
85.44	12.03	0.65	0.94	0.93	—	(0.08)		75000	45000	12	164
84.88	11.94	0.63	0.91	1.42	—	(0.08)		96000	61500	11	200
Bal.	(12.0)	0.57	0.93	1.76	—	(0.08)		88500	60000	10	200
Multiple Deoxidation											
Bal.	(12.0)	(0.6)	(1.0)	(1.5)	(0.1)	(0.05)	Ca (0.05)	98000	68250	9	218
Bal.	(12.0)	(0.6)	(1.0)	(1.5)	(0.05)	(0.05)	Ca (0.05) Ti (0.05)	89700	65700	7	218
(2) Bal.	(12.0)	(0.6)	(1.0)	(1.5)	(0.05)	(0.05)	Ca (0.05) Ti (0.05)	87000	63400	7	200
Effect of Nickel											
Bal.	(9.0)	(0.6)	(1.0)	(1.5)	(0.05)	(0.05)	Ca (0.05) Ti (0.05)	73200	54000	6	200
"	(15.0)	(0.6)	(1.0)	(1.5)	(0.05)	(0.05)	Ca (0.05) Ti (0.05)	89000	71100	4.5	218
Effect of Lead											
Bal.	(12.0)	0.58	0.91	1.38	—	—	Pb (0.1)	73500	47900	9	166
"	(12.0)	(0.6)	(1.0)	(1.5)	(0.05)	(0.05)	Ca (0.05) Ti (0.05) Pb (0.25)	68500	56500	4.5	180

Notes: (1) Numbers in parentheses indicate added percentages, all others indicate data from analysis.
(2) Bars from center of 8 x 12.5 x 12.5 in. chill casting.

TABLE III. RESULTS OF TESTS ON CAST FLAT BARS, ¼ x ¾ x 4 IN. EXPOSED IN EES APPARATUS, KURE BEACH, N. C.

Material	Cu	Ni	Fe	Mn	Zn	Sn	Pb	Si	Al	P	Wt. Loss (grams)	Wt. Loss (g/sq in /day)	Wt. Loss (Mg/day[3])	I.P.Y.[2]
13.5 f.p.s.[1] 15 C (60F) for 60 Days														
Hydraulic Bronze	86.3	–	–	–	4.8	4.7	3.9	–	–	–	2.96	0.0076	118	0.019
Composition G	86.9	0.9	–	–	2.7	9.4	0.15	–	–	–	1.04	0.003	47	0.008
70-30 Cu-Ni + Fe	68.26	30.58	0.48	0.61	–	–	–	–	–	–	0.59	0.002	31	0.005
10%Ni-Cu + Fe	Bal.	11.87	1.28	0.94	–	–	–	0.09	–	–	0.72	0.002	31	0.005
12% Ni-Cu + Al	84.4	12.2	0.62	1.09	–	–	–	–	1.5	0.073	0.47	0.001	16	0.003
13.5 f.p.s. 30 C (86F) for 60 Days														
Hydraulic Bronze	86.3	–	–	–	4.8	4.7	3.9	–	–	–	4.41	0.011	177	0.029
Composition G	86.9	0.9	–	–	2.7	9.4	0.15	–	–	–	3.00	0.0077	119	0.018
Mn Bronze	57.93	–	0.63	0.77	Bal.	0.78	–	–	0.65	–	1.54	0.004	61	0.010
10% Ni-Cu + Fe	Bal.	12.0	0.7	0.4	–	–	–	–	–	–	1.25	0.003	50	0.008
70-30 Cu-Ni + Low Fe	69.1	30.5	0.03	0.43	–	–	–	–	–	–	6.29	0.016	247	0.040
70-30 Cu-Ni + High Fe	68.26	30.58	0.48	0.61	–	–	–	–	–	–	0.62	0.002	23	0.004
27 f.p.s. 30 C (86F) for 60 Days														
Hydraulic Bronze	86.3	–	–	–	4.8	4.7	3.9	–	–	–	11.17	0.029	448	0.072
Composition G	86.9	0.9	–	–	2.7	9.4	0.15	–	–	–	5.37	0.014	217	0.035
Mn Bronze	57.93	–	0.69	0.77	Bal.	0.78	–	–	0.65	–	9.12	0.023	362	0.059
10% Ni-Cu + Fe	86.2	11.57	1.14	0.89	–	–	–	0.07	–	0.05	2.99	0.008	116	0.019
12% Ni-Cu + Al	84.5	11.88	0.90	0.69	–	–	–	0.083	1.39	–	2.63	0.007	108	0.017
70-30 Cu-Ni + Low Fe	69.1	30.5	0.03	0.43	–	–	–	–	–	–	5.80	0.015	232	0.038
70-30 Cu-Ni + High Fe	68.26	30.58	0.48	0.61	–	–	–	–	–	–	0.89	0.002	31	0.005
Monel	(Wrought, Machined)										0.10	< 0.001	4	0.0006

[1] f.p.s. = Feet per Second
[2] I.P.Y. = Inches per Year
[3] mdd = Milligrams per square decimeter (16.5 sq. in.) per day.

80-manganese, then the aluminum, if any, and finally the deoxidizers. The deoxidizers consist of 0 to 0.08 per cent phosphorus, and up to 0.15 per cent silicon for the iron alloy and 0.05 per cent phosphorus, 0.05 per cent titanium and 0.05 per cent calcium as calcium-silicon in the aluminum-containing one, added in this order.

Iron added to the melt in the form of small broken pieces of high purity pig iron was found to go into solution much more readily than ingot iron or steel punchings, because of its lower melting point. The carbon in the pig also causes some deoxidation with a mild effervescence upon addition and probably helps increase the percentage of iron recovery.

Aluminum can be added either in the furnace or ladle on those melts where desired. The melt should not be superheated above 2700 F after this addition as high oxidation losses are encountered. Preheating the ladles is preferable to superheating the metal.

A pouring range of 2500 to 2275 F was found to work well with the cupro-nickel aluminum alloy. Pressure type castings of the latter alloy have been successfully made in the pouring range of 2350 F to 2550 F.

Sand. In the production of green sand molds, a synthetic sand of washed and dried silica sand with about 5 per cent bentonite bond is preferred. Moisture is best held around 4 to 5 per cent for workability and freedom from moisture reactions that result in gas porosity. Sponging should be avoided, or if used the molds should be skin-dried before pouring. A satisfactory sand mix for these alloys is as follows:

100 lb. washed silica sand, AFS 60-70 gfn
5 lb. bentonite
4 pints water
5 minutes mulling

Natural sands of high refractory quality with permeability of not less than 40 to 50 and well vented should produce as satisfactory castings as the synthetic mixes.

Regardless of the sand used, mold hardness should be controlled. In handling any alloy with a linear shrinkage of 1/4 in. per ft, molds rammed just hard enough to resist washing are best. Rammed pattern gates and runners give better results in synthetic sand mixes. Less washing is likely to occur than with hand cut ones, and more accurate size and placement can be obtained.

Silica washes should be avoided. Little improvement was found in the appearance of the castings made in molds so treated. Some porosity was evident and thought due to lowered permeability or an incompletely dried wash.

Thoroughly baked oil-sand cores of low oil content, kept dry and clean, have produced good pressure tight castings. Whistlers and gas vents should always be provided. Careless smears of core pastes on the metal sides of cores have caused blows and porosity.

Some non-siliceous parting dusts have been found to be troublesome if used in excess or allowed to accumulate in corners. They break down at high temperatures and produce gas ($CaCO_3 \rightarrow CaO + CO_2$) from about 900 to 1200 F, resulting often in parting line porosity.

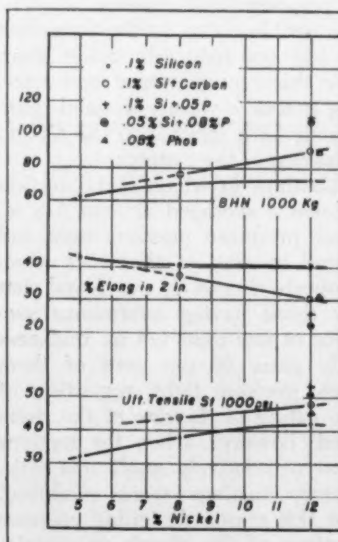

Fig. 4 . . Deoxidation effects.

Fig. 5 . . Iron modification creates no secondary phases

Fig. 6 . . Aluminum addition forms hard Ni-Al compound

Gas from any source should be kept to a minimum in the aluminum-containing bronzes. Even though the gas escapes or is ejected through the metal wall during freezing, it will surely leave an oxide film path through the metal that will leak during pressure testing.

Gating and Risering. As with all alloys containing even small percentages of aluminum, production of pressure tight castings is a serious problem due to the formation of the non-reducible oxide films. For this reason gating and risering practices were examined quite closely with relation to the section thickness of the castings.

Castings in which metal section thickness averaged at least 3/8 in. were produced pressure tight and sound in most of the trials when properly risered. It was found that for those having continuous sections of less than 1/4 in. thickness only some 50 per cent of them were pressure tight, regardless of the gating or the size of the risers used; however, when the sections were of relatively small area satisfactory castings were produced. For this reason designing pressure castings of the aluminum-containing alloy to have thicknesses less than 1/4 in. is not recommended.

Patterns and all gate and runner systems should be mounted upon matchplates where practical. Allow ample runner capacity and fixed prints for the risers. The study of the runner system also brought out that if round section risers are used, none should be less than 2 in. in diameter. Sufficient height is a must to prevent piping into the casting.

Refractory type skim gates are of assistance in breaking up continuous films. The gates, however, should have large enough area to prevent appreciable choking, and be properly placed to cause the least turbulence of the metal stream.

Melting Equipment. These alloys have been melted in both the electric induction and oil-fired crucible furnaces. They can probably be melted in clay-graphite crucibles in almost any type melting equipment capable of attaining 2600 F. Indirect arc furnaces may prove adequate since other cupronickels have been melted satisfactorily in them.

Clean furnace linings or new crucibles that have never been contaminated with lead should be used exclusively for these alloys. As much as 0.4 per cent lead has been found in melts made commercial in allegedly "clean" furnaces that resulted in badly cracked castings. Melt floor supervision to impress the necessity of careful handling to keep leaded or contaminated scrap out of these melts generally pays dividends in high strength, sound, quality castings that will meet specifications.

Microstructure

The microstructures of both alloys have been examined quite closely during this investigation. Typical examples are shown in Fig. 5 and 6.

Fig. 5 shows the cupro-nickel, iron modified alloy as an alpha solid solution with no secondary phases. Fig. 6 shows the aluminum modified alloy as a coarse dendritic alpha solid solution with a secondary phase of a high nickel-aluminum compound that is believed to be associated with the hardening of these alloys.

Corrosion Resistance

The sea water corrosion resistance of these alloys has been determined on several different types of testing apparatus at varying speeds and temperatures from specimens cut from sand castings. Tests were carried out in full strength, clean sea water.

The apparatus used in making these tests were described by LaQue and Mason[2] and the results are set forth in Table III and IV.

The Engineering Experiment Station, or E.E.S., apparatus was developed by the Navy at Annapolis, Maryland. It consists of a motor-driven horizontal shaft on which are five discs, 10¾ in. in diameter used for mounting the test specimens. This assembly is rotated at controlled speeds inside of a 48 in. long by 37 in. wide by 46 in. deep, Thiokol lined monel tank.

Fresh sea water is fed into this tank to a depth of 42 in. from a constant head source. The rate of feed keeps the water at a constant temperature during each test. The speeds are controlled by the motor to run between 13.5 and 27 ft per sec at the tip end of the test specimens. The specimens measure ¼ by ¾ by 4 in. and are mounted as 12 pairs of two per disc.

The jet impingement apparatus was also used. It consisted of eight identical venturi-type nozzles, ⅛ in. inside diameter, set into the side of a tank 2 ft long

by 6 in. wide by 6 in. deep and divided into eight compartments, one for each nozzle. These jets are fed from a source at a constant head of clean sea water.

The water overflows the boxes through a triangular weir and can be measured to control the flow which is normally set at 12 ft per sec or at 20 ft per sec. Air can be added to the jet stream by the use of an aspirator apparatus in conjunction with the venturi-type nozzles. Water once used all goes to waste. Impingement is from a distance of ¼ in. from nozzle to specimen. Specimens are about 1½ by 1½ in. by any desired thickness. They are insulated from contact with other metal by bakelite frames and washers so as not to introduce galvanic corrosion along with the impingement attack.

TABLE IV. ASPIRATOR TYPE SEA WATER JET TESTS, SHOWING EFFECTS OF COMPOSITION AND AIR BUBBLES, 27C (80F)

Alloy	Code	Cu	Ni	Fe	Mn	Zn	Sn	Pb	Si	Al	P	As	Wt. Loss (grams)	Wt. Loss (mg /day)	Depth of Attack (in. /month)	Velocity (f.p.s.)	Days in Test
Admiralty	a*	70.7	—	0.02	—	28.1	1.15	0.01	—	—	—	0.03	0.7323	16	0.007	12	45
	b	"	—	"	—	"	"	"	—	—	—	"	0.3719	8	0.009	12	45
70-30 Cu-Ni + Fe	c*	69.21	30.01	0.51	0.27	—	—	—	—	—	—	—	0.1616	6.7	0.002	20	24
	d	"	"	"	"	—	—	—	—	—	—	—	0.0609	3	< 0.001	"	"
Al Brass	e*	76.42	—	0.07	—	21.46	—	0.01	—	1.98	—	0.06	0.2726	11	0.007	"	"
	f	"	—	"	—	"	—	"	—	"	—	"	0.2606	11	0.005	"	"
12% Cu-Ni + Al	g*	Bal.	12.5	0.24	0.45	—	—	—	—	1.58	—	—	0.1256	5	0.004	"	"
70-30 Cu-Ni + Fe + Al	i	Bal.	30.0	0.57	0.66	—	—	—	—	1.6	—	—	0.0218	< 1	< 0.001	"	"
10% Cu-Ni + Fe	h*	89.04	9.96	0.79	0.22	—	—	—	—	—	—	—	0.1404	3	0.001	"	45

Note: * Air added at about 3%. Others no air added to jet. Alloys are all in wrought condition.

From the results obtained by the use of the described apparatus, comparison of several of these alloys and some of the more common copper base ones have been set forth in Table III and IV. Data are shown in Table IV for wrought alloys tested in the jet impingement apparatus to illustrate the effects of composition on the erosion resistance of the alloys.

The cupro-nickel-iron modified alloys and the cupro-nickel-aluminum modified ones behave about like the 70-30 cupro-nickel alloys containing iron and somewhat better than most of the other copper-base alloys. The increase in temperature takes its toll from many of the alloys. However the iron and aluminum modified cupro-nickels demonstrate good resistance to erosion-corrosion under quite drastic conditions.

Conclusions

1. A 12 per cent nickel-copper alloy containing 1.5 per cent aluminum, 1 per cent manganese, 0.6 per cent iron and deoxidized with 0.05 per cent each of phosphorus, titanium and calcium as calcium silicon will have a tensile strength of 95,000 psi and is suitable for pressure and structural castings for use under severe marine corrosion conditions.

2. A 12 per cent nickel-copper alloy containing 1 per cent manganese and 1.2 per cent iron will have a tensile strength of 45,000 psi and is suitable for pressure castings.

3. Corrosion tests in sea water show these alloys to be superior to the commonly used bronzes.

4. Ample gating and risering practice along with non-turbulent handling of the metal are necessary with the aluminum containing alloy to produce sound pressure tight castings.

5. Lead has been found to lower the mechanical properties as much as 30 per cent. Lead should be kept out of all silicon deoxidized bronzes, due to hot shortness and cracking in the castings when 0.1 per cent or over is present.

6. High strengths of the order obtainable only in specially alloyed bronzes or in the heat treatable bronzes can be produced in the as cast condition with the aluminum containing alloy.

Acknowledgments

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This article is the preprint of a paper entitled "*Production and Properties of Aluminum Alloyed Cast Cupro-Nickel,*" which will be presented at a Brass and Bronze session of the 1957 AFS Castings Congress and Engineered Castings Show in Cincinnati, May 6-10.

VACUUM DIE CASTING OPENS NEW FRONTIERS IN DESIGN

DAVID MORGENSTERN / *Vice-Pres.*
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Colored or clear anodized finishes and thin wall sections now possible in die castings

Die casting has become the shortest, fastest line between raw-material and finished product. No other process can meet the automotive and home appliance mass production needs for non-ferrous castings quite as well as die casters. If you need over 1000 identical pieces in a zinc, aluminum, magnesium, or copper base alloy, with accurate dimensions, smooth surface, and no machining—LOOK TO DIE CASTING.

The recent commercial application of vacuum to the die casting process has produced zinc and aluminum castings with properties comparable to non-ferrous forgings. Drastic reduction in wall sections without losing strength has lowered costs to the point of making die castings competitive with stampings. Aluminum castings made by the process can now be anodized to give a durable, clear finish formerly unattainable.

In the past decade a large upsurge in the use of die castings has been evident. Paralleling this increase in the volume of die casting production, there has been a corresponding increase in the many difficulties inherent to the die casting foundry. The user of die castings is no longer satisfied with a fairly simple casting having a mediocre surface finish. With the advent of the modern high pressure, high speed die casting machine, the die casting purchaser has become more critical in his demands for quality in the product.

There have been many improvements in both the alloys used and in the design and construction of

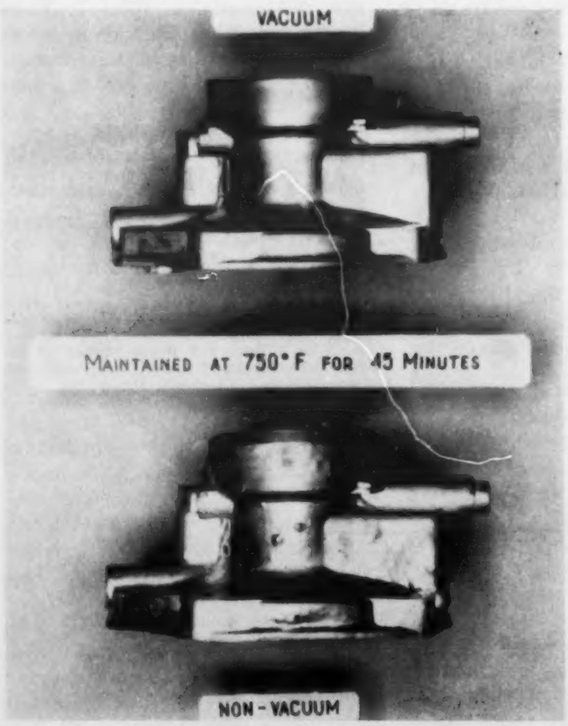

Fig. 1 . . Casting finish can be destroyed by the effects of air trapped in the mold during pouring.

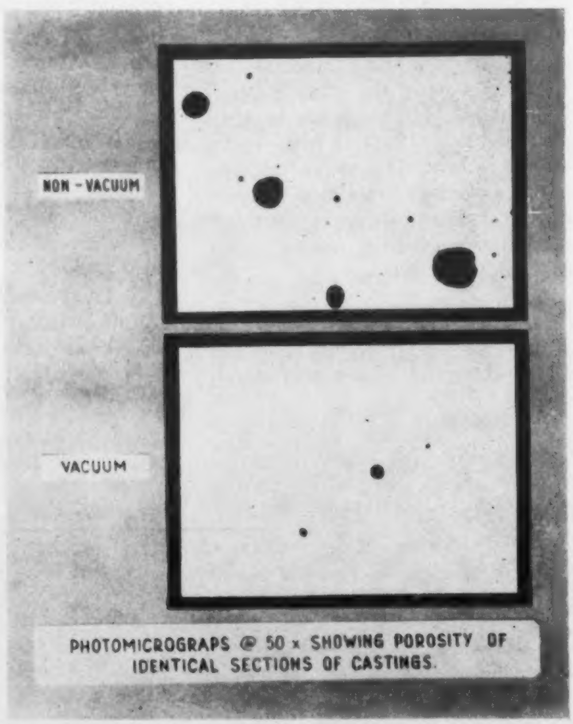

Fig. 2 . . Stronger castings result because vacuum process eliminates the air that would be entrapped.

modern die cast machines. Still, certain limitations continue to prevail in the die casting industry in spite of all the improvements attained in the past ten years.

Air Entrapment

One of these limitations is entrapment of air in the mold during pouring. This problem is not serious in permanent mold casting.

In pressure die casting, the extremely high speeds and high pressures of molten metal injection into the die often results in extensive air entrapment. The metal is broken up into a fine spray when injected through the thin gate into the die cavity. The spray coats the interior of the die surface. Any air vents that may have been put in to remove air are effectively sealed so trapped air cannot be expelled. Most of the air remains trapped as porosity within the casting by the rapid solidification of the molten metal in the die.

In order to minimize the effects of this porosity, high injection pressures are introduced to compress this trapped air into small cavities that do not detract from the practical use of the casting. However, most die castings are made up in cross section of a tight, dense skin, surrounding a porous structure of metal and entrapped air. Porous metal is the cause of many difficulties such as entrapment of plating solutions, blisters forming during finishing operations and lowering of physical properties. Also, porosity has been the reason for the non-uniform physical characteristics of a die casting, versus the uniformity of a permold casting.

Dies for die casting are expensive to make. An average die casting die requires a great deal of cut and try work to determine the proper vents and overflows to minimize air entrapment. Many times it is almost as costly to try out and break in a die properly as to build a die in the first place. Adding overflows and changing runners to the die cavity to obtain proper heat balance in the die may establish undesirable fluid flow patterns causing further air entrapment.

Caught between two opposing

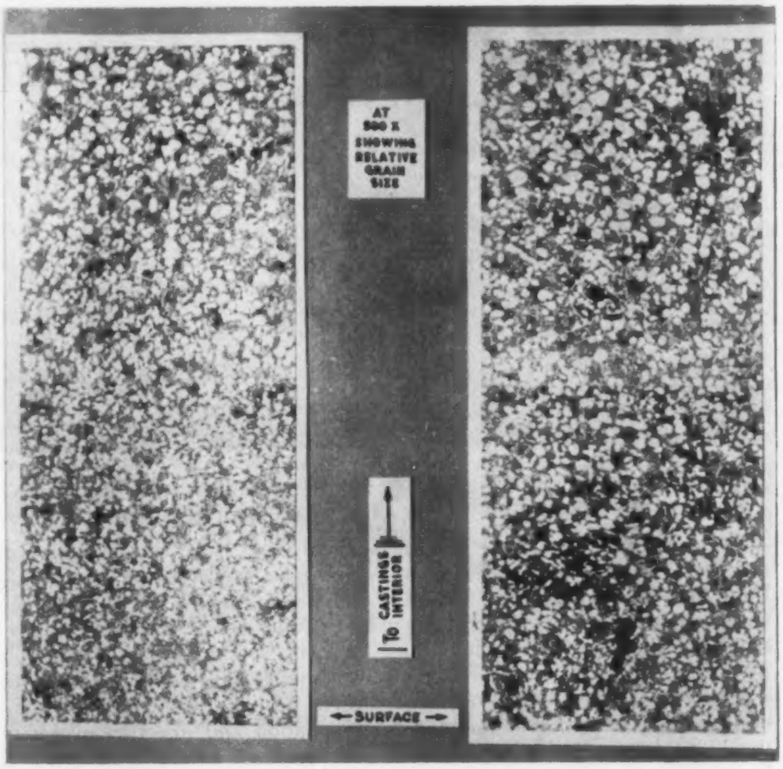

Fig. 3 . . Superior quality of vacuum cast metal, left is a result of lower porosity and denser grain than non-vacuum cast metal, right.

forces, the final development of die layout and treatment of the die is a result of a compromise which may or may not give the desired results.

Previous Efforts

Since the inception of the die casting technique, there has been a constant effort to use the most obvious tool to eliminate this problem. That is, for a way or technique in which to die cast with the dies in a vacuum. This has been done many times on a laboratory basis and proven to be the ultimate answer for the removal of trapped air. Laboratory experiments have shown that if the dies could be properly evacuated, the injection pressures needed to produce fine castings could be greatly reduced.

In high-pressure machines a large percentage of the injection pressure is applied primarily for the compression of air into small bubbles in the casting to minimize the porosity. Consequently, injection pressures have been increasing and as a result, locking pressures have had to be made correspondingly greater.

In examining the patent literature, it is found that practically all of the patents have centered around one central plan—close the dies, then by various means, such as slides, moving core pins or special valves, evacuate the die and inject the molten metal into the die. Many of the schemes which look good on the drawing board become impractical upon application in actual foundry operations because of heat and molten metal problems.

Hood Covers Platen Area

In the author's system, the approach to this problem has been attacked from a different angle. In this system, a complete enclosure,

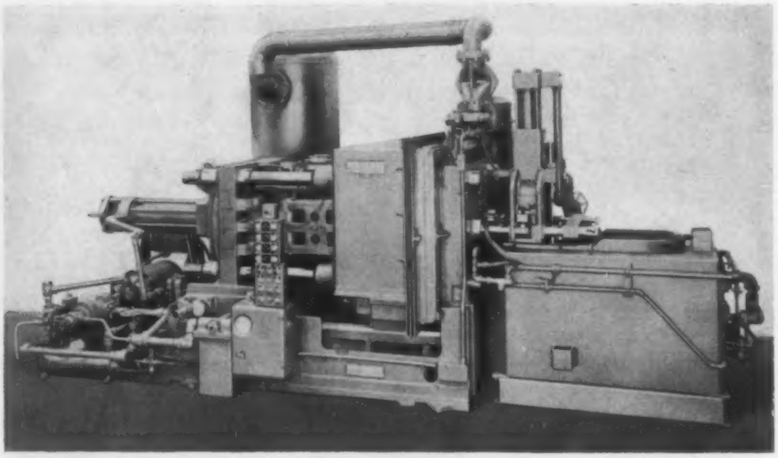

Fig. 4 . . Hood around dies on 400-ton hot chamber machine is both vacuum chamber and safety shield to block leaking metal sprays.

or hood, is built around the platen area of the machine. The hood is built in two sections. One section surrounds the moving platen of the machine; the other surrounds the fixed platen of the machine. The mating surfaces of these hoods are equipped with a suitable shielding device, and enough telescoping action is built into the hoods to allow for variation of die heights. The basic improvement of the hood is that the machine upon closing, seals the mating surfaces of the hood while the die faces are still some distance apart.

At this point the system is evacuated by an accumulator storage tank. The die continues to close up and is fed with metal in a completely evacuated system. This hood also alleviates the necessity of putting shields on the die faces or worrying about the problem of flash or escaping metal sprays. In fact, the hood becomes an enclosure which adds to the safety and cleanliness of the operation.

Proper access doors have been arranged in the hood so that hydraulic cylinders for core pulls and slides can be installed in the hood. The hoods are arranged so that by very simple locking devices the hoods can be removed in a matter of a few minutes for servicing and installation of dies.

Precautions are necessary to prevent metal from being drawn up into the dies in the hot chamber machine, used for the manufacture of zinc alloy castings. A suitable valving device is built over the feed hole port which permits metal to be fed into the charging cylinder of the injection system. This valve is operated in cycle with the evacuation and injection cycles of the machine. The feed port is closed off while vacuum is being drawn, so no metal can be brought up into the dies inadvertently.

System is Automatic

After the vacuum has reached the desired level, the metal shot is made. The vacuum is then released by opening an atmosphere intake valve. The entire process is synchronized automatically with timers and limit switches, so that it becomes completely automatic in operation. Commercially optimum results are obtained at a vacuum level of 15 to 18 in. of mercury. The increment of improvement below 18 in. drops off rapidly and has not been found worthwhile.

Because of the large size valves and orifices used, the evacuation cycle is very fast. It takes place in a small fraction of a second so that there is no slow down of the machine in its operation.

Because there is no entrapped air in the casting, blistering of the hot castings will be minimized. Castings can be ejected from the die after a shorter cooling period necessary to resist blistering, thereby realizing an increase in the cycle speed of the machine. In practical operation, this increase in cycle speed will amount to as high as 25 per cent of the overall cycle time of the machine. Since vacuum castings can be heated without forming surface bubbles, it is quite possible that additional heat treatments to aluminum die castings can now be accomplished to increase their mechanical properties.

Addition of Silicon

The vacuum system, as applied to the cold chamber machine used on aluminum and magnesium, has brought forth another important development. The vacuum is utilized for the pulling up of metal directly from the furnace into the charging cylinder. This expediency

TABLE I. ALLOY DIE CASTINGS
(4% Al — 0.04% Mg — bal Zn)
TENSILE STRENGTH

NON-VACUUM		VACUUM
37,400 psi.		41,100 psi.
40,600 psi.		43,500 psi.
37,400 psi.		44,100 psi.
42,400 psi.		42,800 psi.
29,600 psi.		43,700 psi.
29,200 psi.		42,000 psi.
	Average	
36,100 psi.		42,866 psi.
	Rockwell H	
104.7	Average of Six	105.2
	Weight Relationship	
150.50 grams	Average of Six	151.38 grams
	Per cent increase in weight of vacuum casting	0.58%

Castings were made by a 400-ton hot chamber die casting machine operating at 700 psi hydraulic pressure. Tests were taken from castings run alternately under atmosphere and under 16 to 18 in. of mercury vacuum gauge reading. These tests were performed on panels cut from the surface section of a die casting with 0.045 in. wall section.

eliminates the need for hand ladling, or auxiliary automatic devices. In the ladling of metal into the cold chamber, there is a definite heat loss experienced. Without silicon this temperature range is too short to permit practical operation, and the addition of silicon has made the casting of aluminum practical under these conditions.

However, this additive has prevented successful anodizing of aluminum die castings by the reaction of the silicon with the anodizing process turning the casting black or smutty. The molten aluminum is oxidized in the ladling process and in the charging stroke within the cold chamber. The anodized castings have an objectionable appearance due to the oxide inclusions and oxides in the surface of the casting being etched out by the anodizing process.

Using vacuum die casting, the metal is forced into the cold chamber by means of atmospheric pressure. The interval of time needed to fill a charging cylinder is well under a second, so that metal can be run without any temperature loss or exposure to atmosphere. This makes the running of low silicon alloys practical.

The metal is drawn from the center of the aluminum holding furnace charged into the die under vacuum. Consequently there are no surface oxide inclusions in the casting which formerly were picked up from the holding furnace surface or from exposure of the molten metal to air via ladling. The resultant casting, free of silicon and oxides, is readily anodizable. The finish obtained from anodizing these castings is equal to anodizing on sheet or extruded aluminum, opening up an entirely new field for the application of aluminum die castings.

The effect of air compression is magnified in the cold chamber machine since the cold chamber machine normally has a volume of air in the charging cylinder which must be compressed. By evacuating air, the injection piston speed is greatly increased, giving more resultant force for compacting the metal into the dies.

Test results on zinc-base alloy castings, taken from castings made alternately under vacuum and under conventional method, show marked improvement as demonstrated in Table I and subsequent photographs.

Fig. 1 shows the results of air entrapment brought out by heating the casting just below the melting point which allows entrapped air to blister out. Both castings, vacuum and non-vacuum were heated together. Fig. 2 shows comparative air entrapment bubbles under 50 magnifications. Comparative photomicrographs of sections of vacuum and non-vacuum castings are shown in Fig. 3. This demonstrates not only the porosity decrease, but also the denser grain size of the vacuum casting.

Fig. 4 is a picture of a typical 400-ton die casting machine, equipped for hot chamber vacuum casting. A typical 400 ton die casting machine equipped for cold chamber vacuum casting appears in Fig. 5.

Summary

Not only have the physical properties of castings been improved, but the variation of results in runs of castings are stabilized when made under vacuum. Die castings produced under vacuum now more nearly approach the constancy, or physical characteristics, of a nonferrous forging.

Due to the higher physical strengths in vacuum castings, the wall stock of castings can be materially decreased. This saving in weight and cost in production, tends to make die castings economically competitive with stampings and opens new fields to the designer. Where previously wall sections in zinc ran from 0.050 to 0.070 in., and aluminum from 0.080 to 0.100 in., these wall sections can now be drastically cut without losing any physical strength.

The application of anodizing to give colors or a durable clear finish to aluminum die casting, is an important development of this process. The economics of running a die casting machine are improved by the increased speed of operation made possible by this use of vacuum.

With this new development, the future of die casting should continue to expand and take an even more important position in the metal working industry.

This article is the preprint of a paper entitled *"Vacuum Die Casting—Today and Tomorrow,"* which will be presented at a Light Metals session of the 1957 AFS Castings Congress and Engineered Castings Show in Cincinnati, May 6-10.

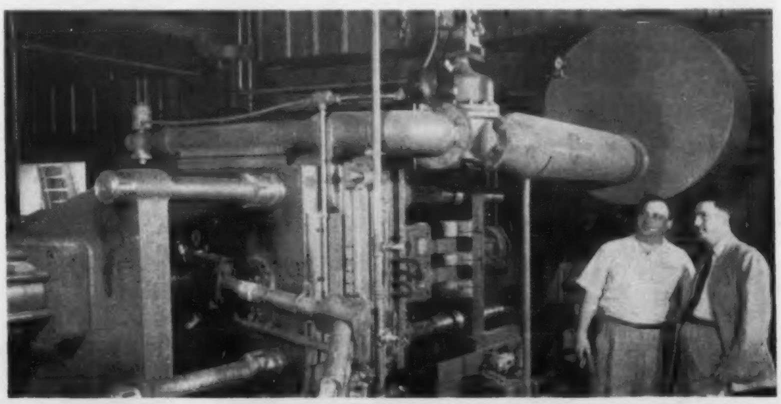

Fig. 5 . . Atmospheric pressure pushes molten metal directly from furnace into vacuumed dies on this 400-ton machine.

CASTING IN SAND TO EXCEED AIRCRAFT SPECS

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Remarkable improvements in physical properties achieved by extensive use of chills in sand casting aluminum

In 1956 the Materials Advisory Board completed a study for the Office of the Asst. Sec. of Defense for Research and Development in which they recommend more use of castings through increased cooperative efforts between aircraft builders and foundries. Today aluminum aircraft castings are principally of alloy 356, ranging in weight from 1 lb. to 185 lb. and averaging a total of 200 to 600 lb. per plane. Increased use is dependent on design engineers full utilization of casting capabilities and foundrymen improving the quality and physical properties through continuing research efforts as exemplified in this Bonus Section.

By resorting to the extensive use of chills in the sand casting of a 22 pound high quality aluminum strategic aircraft casting, remarkable improvements in physical properties were obtained. Compared with minimum specifications, castings made with this technique in alloy 195 showed an improvement of 95 per cent in ultimate tensile strength, 42 per cent in yield strength, and 1300 per cent in elongation. Similar marked improvements were exhibited by alloy 356.

The demand for high strength,

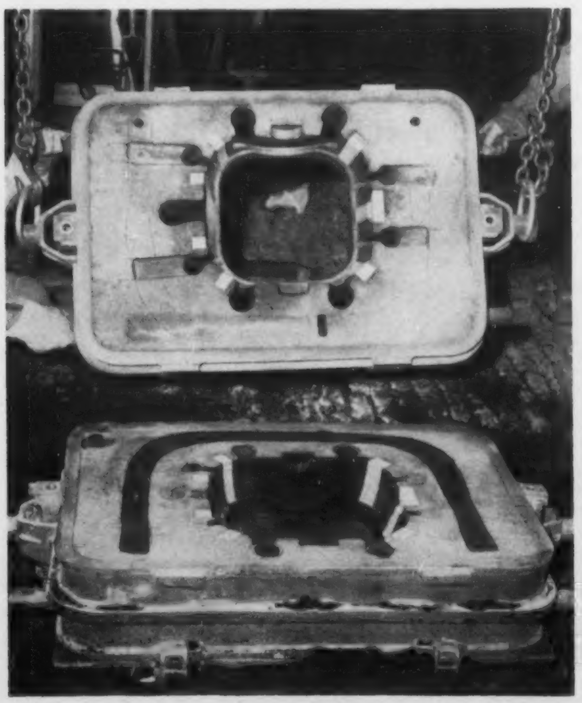

Fig. 1 . . White mold inserts indicate chill locations.

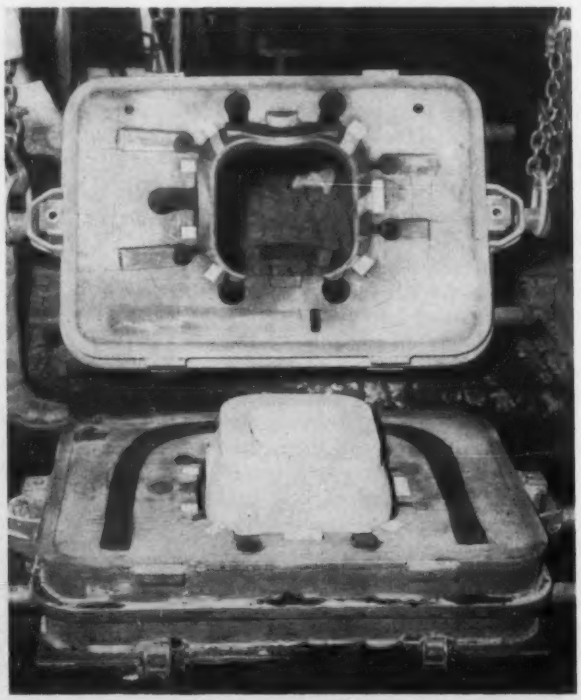

Fig. 2 . . Mold for housing casting with core in place.

high ductility aluminum alloy castings for critical applications is increasing rapidly. Designers in aircraft and other fields are finding service requirements of modern equipment requires the utmost properties attainable in castings. Non-ferrous foundrymen are meeting these needs by closer control of all foundry variables in casting production, and by the expanding use of permanent and semi-permanent molding methods.

Use of permanent molded aluminum castings has come into favor for parts used in critical applications because a well designed permanent mold generally produces a casting with higher mechanical properties than would be obtained from a comparable sand casting[1]. The chill effect obtained from the permanent mold results in inherently stronger, more ductile metal. Permanent mold casting is not economical for short run castings, however, and often is not a feasible method for production of large or intricate castings.

The sand casting method has inherent production advantages. The objective of the present work is to produce a commercial casting, in a sand mold, with mechanical properties comparable to those generally associated with permanent molding.

Chills in Sand Mold

The work described here is based on a previous laboratory study[2] of the effect of chills on the mechanical properties of simple test plate castings. In that study, careful control of all foundry variables (including gas content, chemistry, gating, and heat treatment) was maintained. Chills were placed on plate sections of various thicknesses (at the end of the plate opposite the riser). The effect of the chills on the mechanical properties of the plates was determined.

The chills exerted as markedly beneficial effect on the mechanical properties of the plates at distances well removed from the chill face; for instance, in a one inch thick plate of 195 alloy, the ultimate tensile strength as much as six inches away from the chill was 90 per cent higher than present design minimums.

TABLE I. CHEMICAL ANALYSES OF EXPERIMENTAL HEATS

Heat	Casting	Chemical Analyses (Per Cent)						
		Si	Mg	Cu	Ti	Fe	Mn	Zn
a	195 alloy chilled casting	0.15	0.01	4.42	0.15	0.08	0.01	0.03
b	195 alloy unchilled casting	0.10	0.005	4.55	0.10	0.10	0.01	0.03
c	356 alloy chilled casting	6.9	0.33	0.03	0.15	0.18	0.01	0.03
d	356 alloy unchilled casting	7.38	0.20	0.01	0.11	0.20	0.01	0.03

By careful control of foundry variables and proper placement of chills, it was concluded possible to produce commercial castings with tensile properties up to 100 per cent above present design minimums; and with elongations several times greater than present design minimums.

The present study deals with the translation of the above laboratory results to the production of a fairly large, high quality casting for strategic aircraft use. The casting (one of many of various sizes and shapes made to date) was produced with the same foundry controls used in the laboratory study of the test plate castings. In addition, chills were located on the casting on the basis of design data presented in the previous paper; that is, chills were located at various positions on the production casting in a manner that was expected to raise appreciably the mechanical properties of all portions of the casting.

Procedure

The housing casting shown in Fig. 5 and 6 was chosen for the present rigging study because of its size, reasonable complexity, and variation in section size. The overall dimensions of the casting are approximately 14-1/2 x 15 x 9 in. deep. The wall thickness of the casting varies from 3/8 in. to 1-7/8 in. Net weight is 22 pounds.

Placing Chills

Test castings were heavily chilled according to principles previously described[2]. Essentially, this

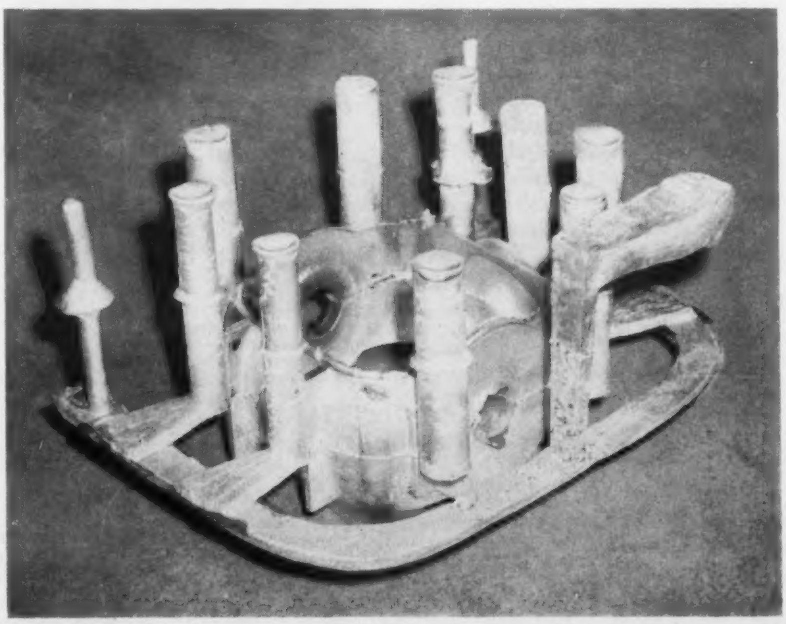

Fig. 3 . . Doughnut-shaped chills were used around cored holes for directional solidification promoted radially toward the risers.

TABLE II. SUMMARY OF FOUNDRY DATA FOR HIGH STRENGTH HOUSING CASTINGS

Alloy:*	195 (H.P.) Heat a: 356 (H.P.), Heat c
Sand:	#140 AFS washed and dried silica sand, 6% southern bentonite, ½% cereal, ½% wood flour, 3—4% water.
Risers:	No.: 9 Dia.: 4 on thin sides 2½ in., 5 on heavy ends 3 in. Height: 12 in.
Chills:	No.: 16 (8 in cope, 8 in drag) Total Wt.: 18¼ lb.
Pouring time:	20 sec.
Pouring temp.:*	1300F, Ht. a; 1250F, Ht. c.
Type of screens:	1/16 in. holes, 50% perforation
Sprue dimensions:	1⅞ x 11/16 in. at base, area 1.29 sq in.
Runner (in drag):	2¼ x 1⅛ in. to first gate, 2¼ x ⅝ in. to second
Gate:	No.: 4 (2 each side) Dimensions: 2¼ x ⅝ in. (corrected for screen)
Gating ratio:	1:4:4
Degas:	Dry nitrogen, 15 min.
Gross wt.:	85 lb.
Net wt.:	22 lb.
Yield:	26%

* Note: One casting was poured of 195 alloy and one of 356 alloy. The above foundry data was the same for both castings, except for alloy and pouring temperature.

involved spacing chills and risers over the entire casting surface so mechanical properties of all portions of the casting would be raised appreciably above the level normally obtained in sand castings.

Most of the wall sections of the casting were 3/8 in. thick and this was the area requiring the most extensive chilling and risering. Previous work had indicated that chilling a 3/8 in. plate section at its extremity would markedly improve the properties along the plate at some distance from the chill. In 356 alloy, for example, mechanical properties of approximately 43,000 psi ultimate tensile strength, 34,000 psi yield strength, and 7 per cent elongation were obtained at a distance one inch away from the chill. At a distance of two inches away the properties were 42,000-33,800-5*.

In the rigging of the present casting it was considered impractical to attempt to attain the higher level of properties stated above. This would have involved chilling the casting so no portion of the 3/8 in. section was greater than one inch from a chill. Chilling the casting so no portion of the 3/8 in. section was more than two inches from a chill was considered feasible. The casting was rigged in an attempt to attain minimum mechanical properties (in 356 alloy) of 42,000-33,800-5. Additional data obtained for 195 alloy indicated that with such a rigging (and the heat treatment used) the casting poured of 195 alloy should possess minimum properties of about 47,000-27,000-12[2].

Riser Influence

In order that no portion of the 3/8 in. section of the casting would be greater than two inches from a chill, the rigging procedure shown in Fig. 1, 2, and 3 was adopted. Bar or "rib" chills were spaced around the periphery of the casting. The distances between the chill edges were nearly constant at four inches. (Slight variations in this distance were present due to casting curvature in the vertical plane). A riser was placed halfway between each chill. The riser was connected to the casting by a 1/2 in. wide riser pad running the entire vertical height of the casting. Spacing from the chill edge to the center of a riser pad was then very nearly 2 in. for the entire 3/8 in. section.

Chilling and risering practice used on the heavier sections conformed to the same principle as described for the 3/8 in. section. The two areas around the cored holes (Fig. 3) were chilled with internal, doughnut shaped chills, directional solidification being promoted radially towards the risers.

The small boss in the location of test bar No. 1 (Fig. 5) was heavily chilled to enable it to freeze more rapidly than the surrounding 3/8 in. section. The heavy section boss in the area of test bars 10 and 11 (Fig. 6) was chilled with a doughnut shaped chill on the exterior of the casting near the periphery of the boss; directional solidification was promoted towards a riser at the center of the boss.

Mold Preparation

A total of 16 chills was used in the mold; the total chill weight was 18-1/4 lb.—nearly equal to the weight of the finished casting. Before molding, the chills were coated with silica-bentonite wash and dried thoroughly. Molds were made of green sand using No. 140 washed and dried silica sand. A gating ratio of 1:4:4 was used, with screens incorporated in the runner to reduce dross entrapment.

To insure a sound casting, overly large risers were used, and a re-

*A shortened nomenclature is used in the remainder of the paper; i.e. 42,000-33,800-5 means 42,000 psi ultimate tensile strength, 33,800 psi yield strength, and 5 per cent elongation.

TABLE III. TYPE AND LOCATION OF TEST BARS IN HOUSING CASTINGS (REFER FIG. 5, 6)

Bar No.	Section Size (in.)	Location	Distance from Chill (in.)	Distance from Riser (in.)	Bar Size (in.)
1	⅜	Beneath Bar Chill	3/16	2	¼ sq.
2	⅜	Halfway between Chill and Riser	1	1	" "
3	⅜	Beneath Riser	2	0	" "
4	⅜	Halfway between Chill and Riser	1	1	" "
5	⅜	Beneath Bar Chill	3/16	2	" "
6	1⅞	Center of Section, Beneath Chill	½	3	" "
7	1⅞	Center of Section	1¾	3	0.505 Dia.
8	⅝	Center of Section	2	3	" "
9	⅝	Beneath Riser	3	0	" "
10	⅝	Between Riser and Ring Chill	¼	1½	" "
11	⅝	Beneath Riser	2¼	0	" "
12	¾	Center of Section, Beneath Chill	¾	1½	" "
13	¾	Center of Section, Beneath Chill	1	1½	" "
14	⅝	Beneath Riser	2½	0	" "

sulting low yield (26 per cent) was obtained. This yield, however, could be raised in subsequent castings, on the basis of the results from these preliminary tests. Table II lists a more complete summary of foundry data relating to the two high strength, high ductility castings.

For comparison purposes, the housing casting was also made using more normal foundry rigging. One casting was made of 356 alloy and one of 195 alloy with no chills incorporated in the mold, but using metal of the same good quality used for the chilled castings. Fig. 4 is a photograph of this rigging as used for both alloys. Six risers were employed, each 3 in. in diameter. Yield was 28 per cent. The same gating system was used on these castings as on the chilled castings.

Melting

Four housings were poured, two in 195 alloy, and two in 356 alloy. Melting stock was high purity virgin materials. Final chemical analyses of the four castings are listed in Table I.

In the melting practice of both alloys, the high purity aluminum pigs were charged first. Non-volatile alloying elements (all elements except magnesium) were added shortly after melting began. The magnesium was added to the 356 alloy melt just before degassing. Degassing was accomplished with a special grade of dry nitrogen (dew point—73 F). The nitrogen was bubbled through the melt for 15 minutes at 1200-1300 F. Gas content was checked with a reduced pressure tester[3]. The metal was held five minutes before pouring to allow dross flotation.

Cleaning and Heat Treatment

Cleaning (a slightly greater problem with the heavily chilled casting than with the more normally rigged casting) was performed without difficulty using standard equipment:—a band saw, belt sander, and rotary hand sander. A final sand blast was given the casting before the photographs of Fig. 5 and 6 were taken.

Heat treatment was done in a small connection type furnace. Both the 195 and 356 alloy castings were given a modified T6 treatment (for high yield strength). Alloy 195 was solution heated at 960 F for 16 hours, water quenched, held at room temperature for a minimum of 24 hours, and aged at 310 F for 15 hours. The heat treatment of alloy 356 differed only in that 1000 F was used for the solution treatment and aging required only 12 hours.

Physical and Mechanical Testing

Each of the housing castings was x-rayed 100 per cent. All castings, including the unchilled casting were found to be free of shrinkage in the test bar areas. One small shrink area was noticed in the chilled castings, indicating the need of a minor rigging change at this location. Otherwise, all castings were entirely free of visible x-ray shrinkage porosity.

After heat treatment, the test bar coupons sketched in Fig. 5 and 6 were cut from the casting and machined into tensile specimens. Table III lists (for each specimen number) the size bar machined, the section thickness from which the test bar was taken, and the location of the bar with respect to chills and risers. The test bar locations were chosen as being representative of the casting as a whole, most other possible locations being similarly risered and chilled.

Properties Obtained

Mechanical property data from the four castings tested are listed in Tables IV, V, VI, and VII. Tables IV and V present the data for the chilled and unchilled 195

TABLE IV. MECHANICAL PROPERTIES OF HIGH STRENGTH, HIGH DUCTILITY, 195 ALLOY HOUSING (HEAT *a*)

Bar No.	U.T.S. (psi)	Yield St. (psi)	Per cent El. (for 2 in.)
1	49,000	32,300	11.0
2	51,900	32,700	11.0
3	41,500	25,200	6.0
4	51,300	24,400	14.0
5	49,900	31,500	9.5
6	51,100	25,800	16.0
7	42,700	29,500	6.0
8	39,700	28,300	5.0
9	39,800	24,000	7.5
12	53,500	30,100	13.0
13	45,500	29,000	9.0
Average	46,900	28,400	10.0

TABLE V. MECHANICAL PROPERTIES OF COMMERCIALLY RIGGED 195 ALLOY HOUSING (HEAT *b*)

Bar No.	U.T.S. (psi)	Yield St. (psi)	Per cent El. (for 2 in.)
1	34,800	*	5.0
2	41,500	*	4.0
3	36,300	*	1.0
4	44,200	*	6.0
5	43,300	*	4.0
7	28,600	23,400	1.0
8	28,400	24,400	1.0
9	38,400	25,900	5.0
10	37,400	22,400	7.5
11	33,500	19,300	6.0
12	33,500	28,500	3.5
13	34,000	28,900	3.0
14	46,000	28,800	9.0
Average	36,900	25,200	4.3

* Yield strength not obtained.

TABLE VI. MECHANICAL PROPERTIES OF HIGH STRENGTH, HIGH DUCTILITY, 356 ALLOY HOUSING (HEAT *c*)

Bar No.	U.T.S. (psi)	Yield St. (psi)	Per cent El. (for 2 in.)
1	43,800	31,500	8.0
2	43,500	32,300	7.0
3	40,400	29,200	2.0
4	42,500	32,650	4.5
5	44,900	34,800	11.0
6	43,600	32,000	8.0
9	40,950	34,000	4.0
10	42,400	32,600	5.0
11	39,800	33,500	4.5
12	43,000	33,400	7.0
14	40,400	33,750	3.0
Average	42,300	32,700	5.8

TABLE VII. MECHANICAL PROPERTIES OF COMMERCIALLY RIGGED 356 ALLOY HOUSING (HEAT *d*)

Bar No.	U.T.S. (psi)	Yield St. (psi)	Per cent El. (for 2 in.)
1	29,900	25,600	1.5
2	31,300	24,700	1.5
3	29,500	28,600	1.0
4	31,700	25,600	2.0
6	32,700	26,900	1.5
7	30,700	26,800	1.0
8	30,100	26,800	1.0
9	32,700	27,000	1.5
10	30,800	25,500	2.0
Average	31,000	26,400	1.4

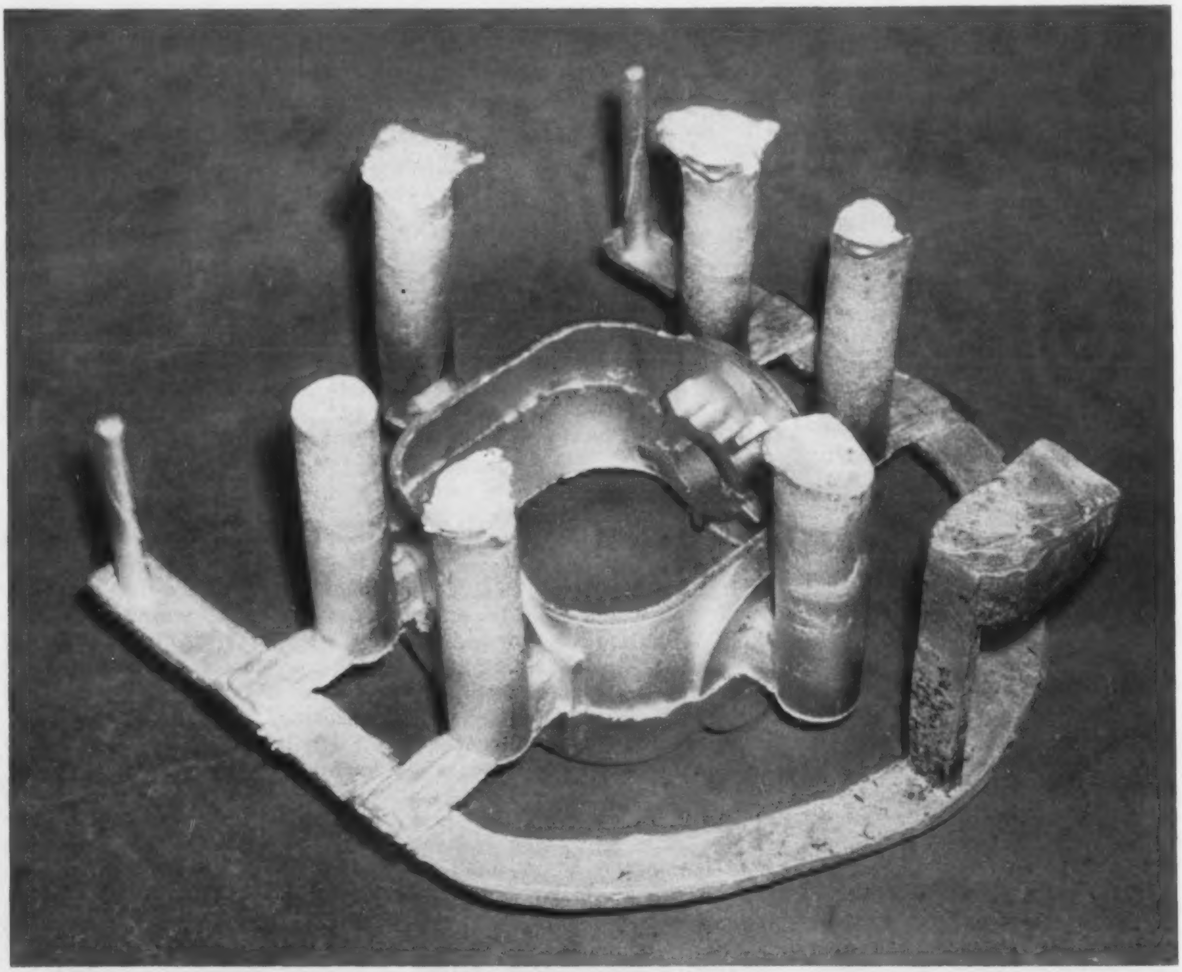

Fig. 4 . . Housing casting was rigged with commercial techniques in which no chills were utilized.

alloy castings. They show that the chilling raised the average properties of the bars tested (in the 195 alloy castings) from 36,900-25,200-4.3 to 46,900-28,400-10. More important, minimum ultimate tensile strength was raised from 28,400 psi to 39,700 psi by chilling, and minimum elongation was raised from 1.0 per cent to 5.0 per cent.

Overall increases in mechanical properties due to chilling were not, however, quite as high as might be expected from a close examination of the simple test plate data previously presented[2].

The mechanical property data for the chilled and unchilled 356 alloy housings, presented in Tables VI and VII, show that chilling raised the average properties of the bars tested from 31,000-26,400-1.4 to 42,300-32,700-5.8. Minimum elongation was raised from 1.0 to 2.0 per cent by chilling and minimum ultimate tensile strength was raised from 29,500 psi to 39,800 psi. For the most part, the properties obtained in the 356 alloy chilled casting are about the same properties that would have been predicted on the basis of simple test plate data.

Chilled vs Sand Castings

It is of interest to compare these results obtained in the chilled sand castings with present design minimums for sand castings. Government specifications permit the average of three test bars cut from a 195 alloy casting to be as low as 24,000-20,000-3/4[3]. The average properties obtained on the chilled housing were 46,900-28,400-10.0, representing an increase of 95 per cent in ultimate tensile strength, 42 per cent in yield strength, and thirteen hundred per cent in elongation (over minimum specifications).

Furthermore, by re-rigging the chilled casting on the basis of results obtained in these trial castings, it should be feasible to produce minimum casting properties approaching this level.

Similar improvement over present casting minimums was obtained in the chilled 356 casting. Here, average properties obtained were 42,300-32,700-5.8, compared to minimum casting specifications (average of 3 test bars) of 22,500-20,-000-3/4 per cent[4]. The average properties of the 356 alloy chilled housing represent an improvement over design minimums of 89 per cent in ultimate tensile strength, 63 per cent in yield strength, and eight fold in elongation.

Summary

The translation of laboratory results in simple test plate castings to the production of a fairly large, high quality casting has been described. By judicious chilling of the casting, and by careful foundry practice, the mechanical properties of the casting were raised substantially above present design minimums.

Properties of coupons cut from the sand casting of 195 alloy made without chills averaged 36,900 psi ultimate tensile strength, 25,200 psi yield strength, and 4.3 per cent elongation. Addition of chills raised these average properties to 46,900 psi ultimate tensile strength, 28,400 psi yield strength, and 10 per cent elongation. Chilling raised the average properties of the same casting made in 356 alloy from 31,000 psi ultimate tensile strength, 26,400 psi yield strength, and 1.4 per cent elongation to 42,300 psi tensile strength, 32,700 psi yield strength, and 5.8 per cent elongation.

The properties of the chilled 195 alloy casting represent an improvement over present minimum specifications of 95 per cent in ultimate tensile strength, 42 per cent in yield strength, and thirteen hundred per cent in elongation. The properties of the chilled 356 alloy casting represent a similar improvement of 89 per cent in ultimate tensile strength, 63 per cent in yield strength and 800 per cent in elongation.

Acknowledgment

The authors wish to express their appreciation to the Pitman Dunn Laboratory, Frankford Arsenal for support of this work.

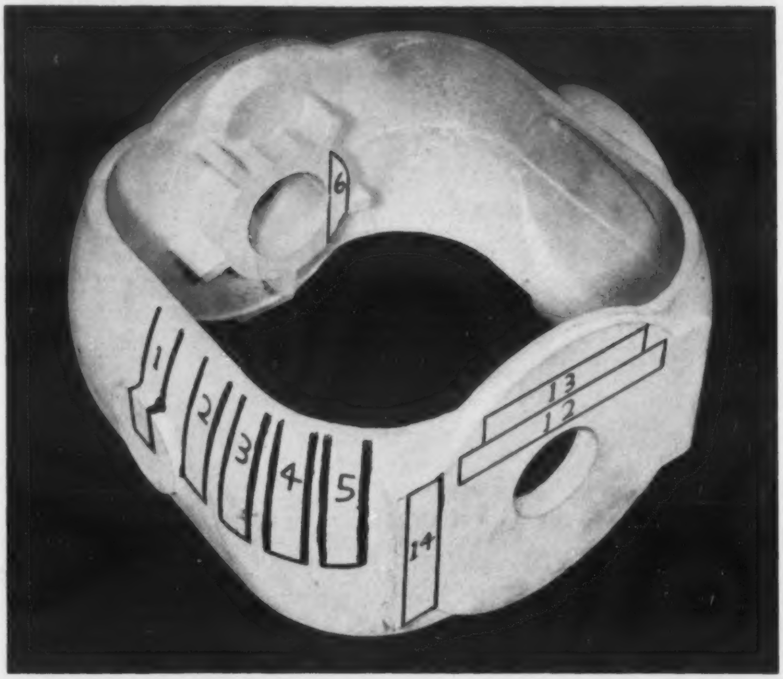

Fig. 5 . . Cleaned housing casting shows location of some test bars. Shape was chosen for reasonable complexity, variations and size.

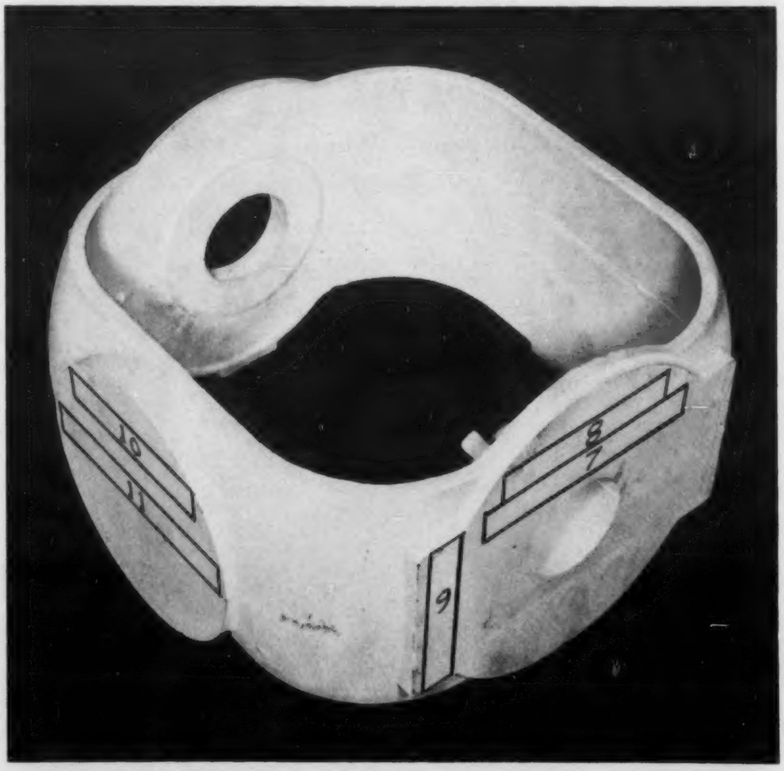

Fig. 6 . . After heat treatment, test bar coupons were cut from casting.

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4. Federal Specification QQ-A-601 (a), 3 February 1950, "Aluminum Base Alloys; Sand Castings."

This article is the preprint of a paper entitled "*Rigging Design of a Typical High Strength, High Ductility Aluminum Alloy Casting,*" to be presented at a Light Metals session of the 1957 AFS Castings Congress and Engineered Castings Show at Cincinnati, May 6-10.

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No. 41—"**Temperature Drop in Pouring Ladles: Part II**"—V. Paschkis and J. W. Hlinka, Columbia University, New York. (AFS Research Progress Report.)

Industrial Engineering and Cost

No. 15—"**An Appeal to Foundry Executives**"—J. A. Wagner, Wagner Malleable Iron Co., Decatur, Ill.

Light Metals

No. 21—"**Performance of Chills on High Strength-High Ductility Sand-Mold Castings of Various Section Thicknesses**"—M. C. Flemings, P. J. Norton, and H. F. Taylor, Massachusetts Institute of Technology, Cambridge, Mass.

No. 30—"**Effect of Nitrogen and Vacuum Degassing and Properties of a Cast Aluminum-Silicon-Magnesium Alloy (Type 356)**"—R. K. Owens, H. W. Antes, and R. E. Edelman, Frankford Arsenal, Philadelphia.

No. 43—"**Hot Tearing of Magnesium Casting Alloys**"—R. A. Dodd, University of Pennsylvania, Philadelphia. (Formerly with Department of Mines and Technical Surveys, Ottawa, Canada; W. A. Pollard and J. W. Meier, Department of Mines and Technical Surveys, Ottawa, Canada.

No. 49—"**Corrosion of Aluminum Die Castings**"—D. L. Cowell and R. J. Kissling, Apex Smelting Co., Cleveland.

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Malleable Iron

No. 24—"**Some Observations on Galvanizing Embrittlement of Malleable Iron**"—R. W. Sandelin, Connors Steel Division, H. K. Porter Co., Inc., Birmingham, Ala.

No. 48—"**Effects of Charge Materials and Melting Conditions on Properties of Malleable Iron**"—E. H. Belter, formerly, University of Wisconsin, Madison, now with Bechtel Corp., San Francisco, Calif.; and R. W. Heine, University of Wisconsin, Madison. (AFS Research Progress Report.)

No. 59—"**Comparison of Properties of Liquid- and Air-Quenched Pearlitic Malleable Irons: Part II—Duplex, Cold-Melt Process and Alloyed Pearlitic Malleable Irons**"—AFS Pearlitic Malleable Committee (6-E).

Sand

No. 8—"**How to Determine Moisture Requirements of Molding Sands**"—R. W. Heine, University of Wisconsin, Madison; E. H. King and J. S. Schumacher, The Hill and Griffith Co., Cincinnati.

No. 20—"**Mold Hardness: What It Means!**"—R. W. Heine, University of Wisconsin, Madison; E. H. King and J. S. Schumacher, The Hill and Griffith Co., Cincinnati.

No. 29—"**Properties of Molding Sands Under Conditions of Gradient Heating**"—N. C. Howells and R. E. Morey, Naval Research Laboratory, Washington; and H. F. Bishop, formerly with Naval Research Laboratory, presently with Exomet Corporation, Conneaut, Ohio.

Steel

No. 36—"**Austenitic Manganese Steel Technology in an Australian Foundry**"—Hedley Thomas, Industrial Steels Ltd., Sydney, N.W.S. Australia. (Official Exchange Paper from the Institute of Australian Foundrymen (N.S.W. Division).

No. 71—"**Effect of Carbon and Manganese on Properties of Constructional Steels for Dynamic Loading Applications**"—R. D. Engquist, American Steel Foundries, E. Chicago, Ind.

Quality Control

No. 66—"**Administrative Engineering Applications of Statistical Methods**"—J. L. Dolby, General Electric Co., Schenectady, N. Y.

No. 67—"**A Foundry Application of the Master Control System**"—N. P. Demos, General Electric Co., Schenectady, N. Y.

Fundamental Papers

No. 56—"**Adhesion of Phenol-Formaldehyde to Various Refractory Oxides**"—J. K. Sprinkle, General Electric Co., Schenectady, N. Y., and H. F. Taylor, Massachusetts Institute of Technology, Cambridge, Mass.

No. 61—"**Fluidity of a Series of Magnesium Alloys**"—J. E. Niesse, M. C. Flemings, and H. F. Taylor, Massachusetts Institute of Technology, Cambridge, Mass.

The following papers appear in issues of MODERN CASTINGS:

"**Improving Foundry Layout**"—December, 1956.

"**High Strength Ductile Aluminum Alloy HP 356 for Aircraft**"—May, Bonus Section.

"**Expendable Graphitic Molds in the Production of Sound, Ductile Titanium Castings**"—May, Bonus Section.

"**Vacuum Die Casting**"—May, Bonus Section.

"**Rigging Design of a Typical High Strength, High Ductility Aluminum Alloy Casting**"—May, Bonus Section.

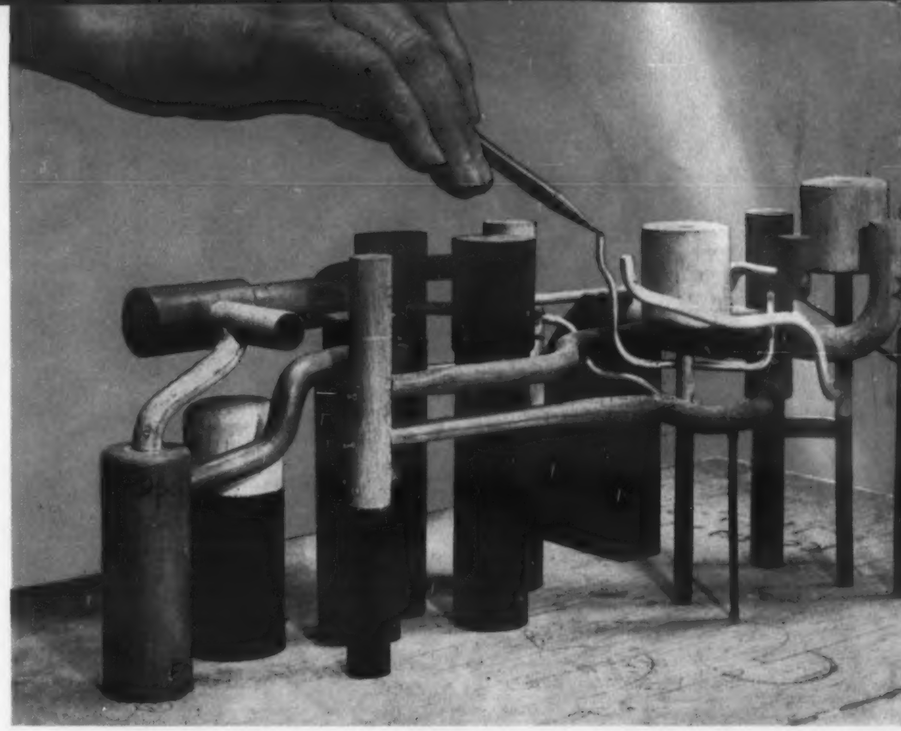
"**Production and Properties of Iron and Aluminum Alloyed Cast Cupro-Nnckel**"—May, Bonus Section.

"**Oil Bonded Molding Sand**"—May.

"**Tin as an Alloy in Gray Cast Iron**"—May.

"**Intricate Small Diameter Coring of Aluminum and Magnesium Alloy Sand Castings**"—May.

"**Influence of Vibration on Solidifying Metal**"—April.



Maze of 17 cores in mock up of coring for aircraft fuel control includes seven tube cores. Pencil touches duplicate of ⅛-in. core.

FORMING INTRICATE PASSAGEWAYS with REMOVABLE SHEATHED-TUBE CORES

Robert F. Dalton /
Research & Development Director
Howard Foundry Co., Chicago

Copper tubes covered with woven refractory core small passages in aluminum and magnesium castings

Small, intricately shaped, unlined passageways in aluminum and magnesium alloy sand castings are being formed by a new technique utilizing pre-formed metal tubing sheathed in a flexible refractory sleeve. Both the tube and the sleeve are removed from the casting after it has solidified.

Holes or passageways in castings are quite commonly made in castings with oil and resin bonded sand cores. In general, cereal, water, and in the case of magnesium alloys, inhibitors such as sulphur and alkali metal fluoborates, are also added to the core sand mixes.

Gas is generated when hot metal is poured against organically bonded core surfaces. This gas must escape through the core rather than bubble through the liquid metal. In order for core gas to escape through the sand the core must be permeable. The rate and quantity of core gas generated during pouring and solidification of the molten metal determines the permeability requirements of the core.

Where the ratio of core length to diameter is large, as in the case of small diameter cores, the escape of core gas through the small area of the core becomes more of a problem. The surface area determines, to an extent, the amount of core gas generated; the cross-sectional area of the core determines the amount of gas that can flow out through it in a certain time. If the gas cannot escape as rapidly as it is formed a blow results in the casting.

Other factors controlling the rate gas is evolved and the ability of the core to eliminate the gas are:

Gas Evolution: (1) Heat entering the system; pouring temperature, Specific heat of metal. (2) Type and amount of binder.

Gas Elimination: (1) Sand Properties, Permeability, Core Venting.

Long, small diameter sand cores are apt to cause core blows. It is difficult to maintain their stability, eliminate distortion, and hold and set them. Naturally, the smaller the sand cores the more difficult they are to make, store, and handle.

Cores may be molded of other refractory materials such as graphite, carbon, plaster, silica flour, powdered glass, etc. Most of these materials require an organic binder, although silica jell binders may be used. Unless the core binder disintegrates when pouring the metal, cores of these materials become very difficult to remove from the casting.

Complex passageways are sometimes produced by drilling the casting. This practice usually requires a rather expensive drill jig. Short, drilled passageways can be joined together to produce more complex holes, but, it is often necessary to tap and plug a hole where it enters a casting. The plug is susceptible to loosening and leakage. The design of drilled holes is quite limited since they cannot follow irregular contours and are restricted to a straight line.

Another popular coring method is the use of a metal pipe or tube that generally remains in the casting. Iron pipes, calrod units, and other similar materials have been cast in aluminum and magnesium for a long time.

Stainless steel tubing has been used for passageways in magnesium alloys. However, it appears that any ferrous tube will be anodically protected by the surrounding magnesium casting, provided the liquid flowing through the tube acts as an electrolyte in the iron-magnesium cell. Stainless tubing returned in scrapped castings presents a problem since nickel and chromium may dissolve in the magnesium melt and exceed permissible limits. Wherever possible, after the magnesium has been melted, the scrapped tube must be removed manually from the melt.

For reasons not too well known, stainless steel tubing is quite difficult to cast in its required position in the casting. It is particularly susceptible to blows. To prevent blows, stainless steel tubing has been treated in many ways. In one method a resistance welder is employed to preheat the tube in the sand mold prior to casting.

At Howard Foundry Co., a process for coring has been developed utilizing a removable tube-core.* After numerous experiments with different metallic pipes, copper was selected as the best tube material. Soft copper tubing may be purchased in fractional inch sizes. When purchased from re-draw mills, almost any outside diameter may be obtained. The pipe is easily bent at room temperature using metal-faced wooden bending fixtures.

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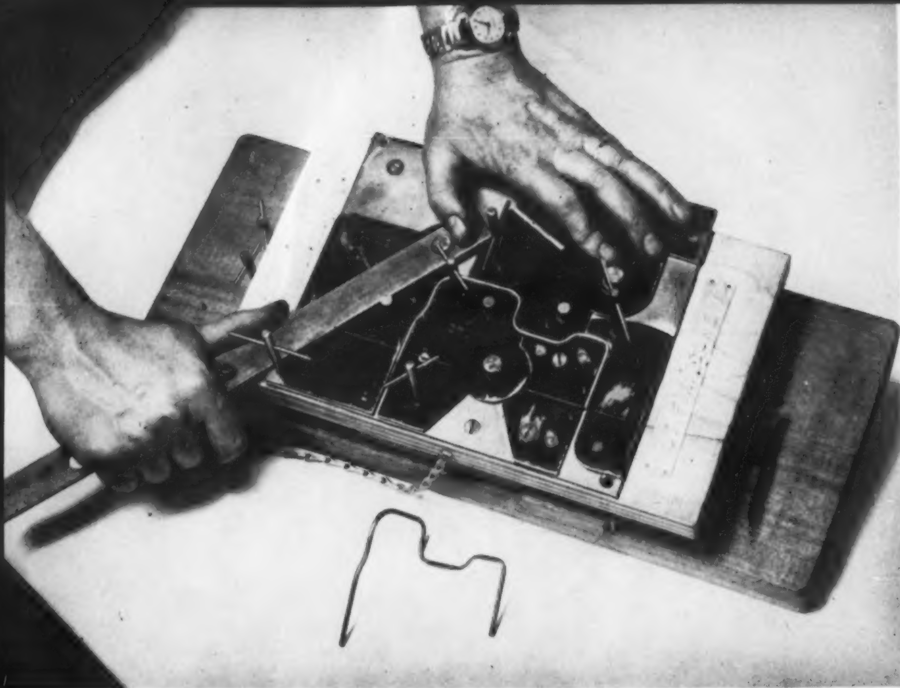
* Patent applied for by Howard Foundry Co.



Simple fixtures are used to bend tube to shape, then it will be sheathed with a fiber glass or braided stainless steel sleeve.

A small allowance for tube "spring-back" is necessary, depending on the initial temper of the tube and the amount of cold work done in the bending operation. If aluminum or magnesium metals are cast around a bare copper tube, it would readily dissolve in the molten metal. Experiments proved a satisfactory wash of silica flour could be used to prevent this solution. A better technique, however, was developed.

Refractory Sleeves

Copper tubes used in aluminum castings are covered with a woven fiber glass refractory sleeve. In the production of magnesium castings a woven stainless steel braiding serves as the covering material. These refractory sleeves serve a three-fold purpose: (1) prevent solution of the pipe; (2) minimize blows off the pipe; and (3) serve as proof of pipe removal.

After the copper tube has been bent to the desired shape, the flexible refractory sleeve is slipped over the sleeve ends and firmly fixed at the ends of the tube. The assembly is then placed in the sand mold. Sometimes steel core prints are attached to the tube ends for a firmer location of the tube in the mold. Setting the tube assembly into an oil sand core is preferable to green sand. It may then be located with the desired metal wall around the tube, and the entire core assembly is then placed in the mold. Care is taken to keep the tube assembly clean of oil, core paste, or anything that might form gas when molten metal contacts it.

The metal is cast in the usual manner. Generally, the tube volume is too small to produce any noticeable chilling effects. Bosses are cast on the castings at the tube prints. After the castings have been shaken out, the tube ends are opened. Air is passed through the tube to be sure of a complete passageway. (Sometimes the tubes are filled with dry sand prior to placing in the mold.)

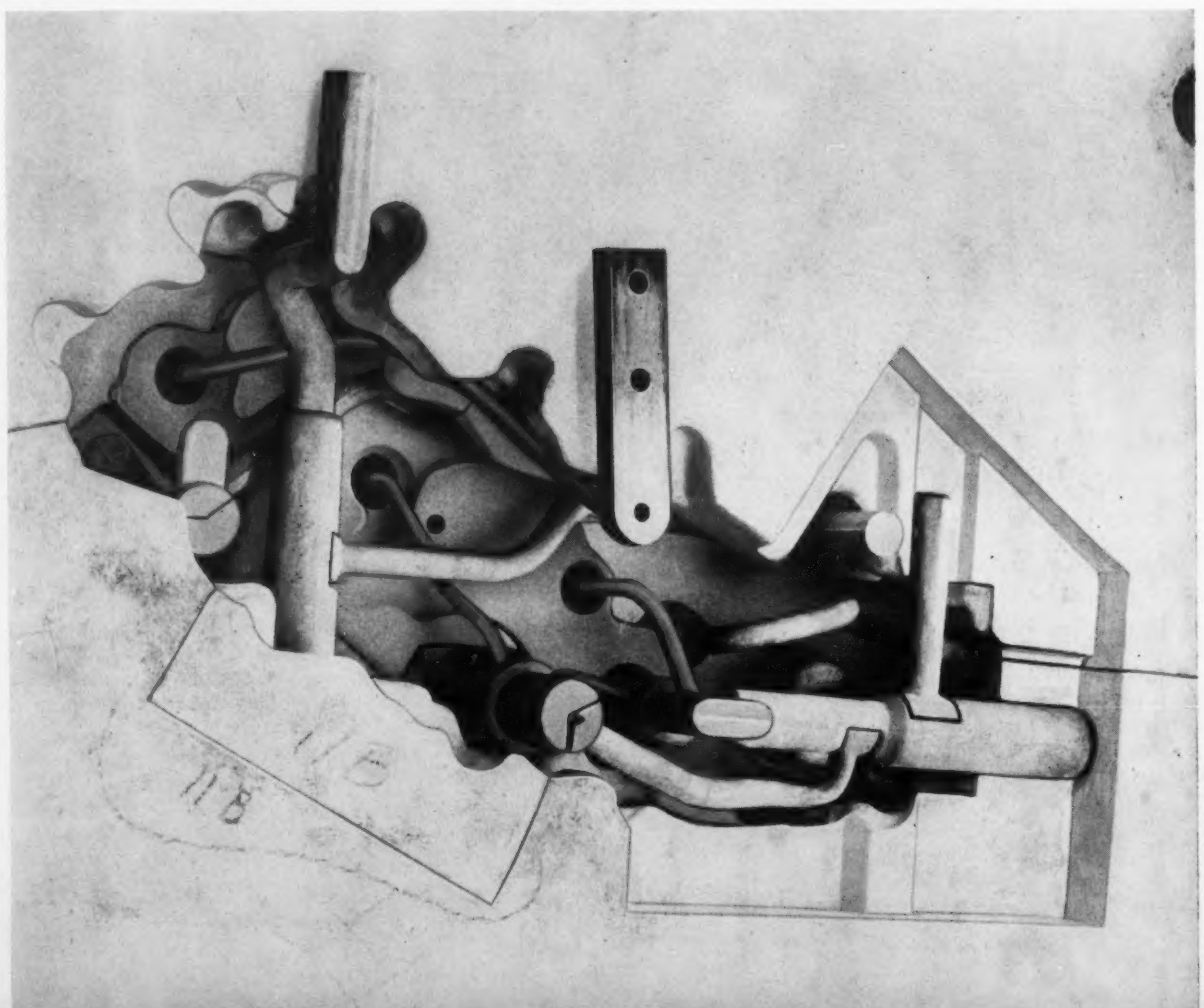
The tube-cores are now removed by an acid-solution technique. Where the tube leaves the casting, a bottom-pour polyethylene bucket of about ten quart capacity is attached with flexible plastic tubing. In the case of aluminum castings, copper tubes are dissolved with a 70 per cent concentrated nitric acid.

The acid is gravity-fed. At one time, small stainless steel centrifugal pumps were used but the motors corroded rapidly. The reaction, $Cu + 2HNO_3 = CuNO_3 + NO_2 + H_2O$ is very rapid and is increased by heating the acid in hot water.

The nitrous oxide gas formed is particularly noxious and should be avoided. Consequently an air washing hood was constructed to eliminate any acid fume problem.

The NO_2 gas coming out of the casting serves as an indicator of

Assembly shown in mock-up will look like this when inserted in the mold. Plaster fixture substitutes for mold.



the presence of copper tubing in the casting. When it appears that the copper tubing has all been dissolved, the system is flushed with water.

Since the fiber glass sleeve extended beyond the print of the copper tube, it extends outside the casting at both ends. After the water flushing operation, the sleeve is easily removed by manually pulling it out. The removal of the copper tube in rather simple cored passageways has sometimes been accomplished manually without the use of the acid wash.

The fiber glass sleeve is not affected by molten metal or the acid wash. Removal and inspection of the sleeve is definite proof of tube removal. Radiographs are not needed to determine clean holes.

Magnesium Castings

In the production of cored passageways in magnesium alloy castings, the process is essentially the same with two exceptions. The sleeve used in stainless steel braiding. In order to prevent solubility of the magnesium alloy casting, the acid solution is approximately one half 70 per cent nitric acid and the other half 70 per cent hydrofluoric acid. The latter passivates the magnesium, and the nitric acid dissolves the copper tubing. The usual necessary precautions in handling hydrofluoric acid must be practiced.

Fiber glass sleeves are not used because they may be partially dissolved by the HNO_3-HF mixture The partial solution of the fiber glass tends to plug the hole and slow the flow of acid.

The stainless steel sleeve is not affected by the acid and has the property of reducing in size. Thus a sleeve that will fit over a 3/8 in. copper tube may be easily withdrawn from a 1/8 in. hole, if the occasion arises.

Size Limitations

The tube method of coring is only used when an oil sand core will not do the job. The normal problems involved in coremaking, such as putting in wires, use of vents (both removable and wax) and pasting or booking halves together, are magnified when making small diameter cores.

Even if the small diameter sand core can be made by a coremaker, handled in the foundry, and set into the mold, core blows may defeat the casting operation. This seems to be more of a problem in magnesium castings, presumably because of the added hazard of skin effect from fluoride films on the surface metal. Such problems as opening of core seams and removal of core reinforcing wires are encountered.

The use of copper tubing eliminates many coremaking problems. With the proper fixture design, bending of the tube may be done with relatively unskilled help. Core breakage in handling is non-existent. The core retains its intended position in the mold because of its rigidity. At the pouring temperatures of aluminum and magnesium alloys (generally 1200-1600 F.), the tube is quite ductile. This ductility allows the tube to contract as the metal solidifies and the casting shrinks with the tube passageway to a smaller size.

The copper tube holds its intended position much better than a stainless steel tube. This may arise from the increased ductility of copper at elevated temperatures, compared to relatively small changes in physical properties of stainless steel at elevated temperatures.

Many of the tube-cored passageways are as small as 1/8 and 3/16 in. diameter. Such diameters are difficult to produce in sand. The core length in these sizes runs to about 16 in., although this is not the limit on length. As the length increases, the diameter of the tube may increase. There appears to be no size limitation on the larger diameter tubes. Larger cores, however, are less expensive in sand.

Cost of Operations

On sand cores that are easily made and where scrap is low, the tube core is not considered because of costs. However with the tubes, castings are being cored that cannot be made by conventional methods. Where an area of comparison exists, the tube method may be lower in cost due to elimination of core breakage.

Small diameter sand cored castings are zyglo inspected in the rough because of the prevalence of core blows. After using tube-cores for several months, preliminary zyglo was discontinued because blows were non-existent.

The removable tube method of coring aluminum and magnesium alloy sand castings may be regarded as an adjunct to conventional sand coring. It will not replace sand core and machine drilling methods, especially where machine drill jigs are already in use.

The removable tube method of coring has proven of great interest to design engineers in the aircraft industry. The method permits greater freedom in designing passageways for transmitting oil, fuel, coolant and hydraulic fluids. Passageways may be internally "wrapped" around a large cylinder in one uninterrupted line. Fluid lines do not have to be hung on exteriors of cast components; they may be an integral part of the component, going in many directions and assuming varying shapes.

The tube method of coring also helps to eliminate weight since the cast component is made to contain intricately shaped fluid lines for unrelated distribution of different fluids. Permanent, cast-in stainless steel tubing is eliminated, with favorable weight reduction.

Because of adaptability of the removable tube-core, increasing use of this method of coring aluminum and magnesium alloy sand castings is expected to satisfy what has, heretofore, been called the "impossible" coring requirements.

Sectioned aluminum sand castings shows 48-in. long continuous cored passageway following contour of casting. Core diameter is ¼-in.

This article is the preprint of a paper entitled *"Intricate Small Diameter Coring for Aluminum and Magnesium Castings,"* which will be presented at a Light Metals session of the 1957 AFS Castings Congress and Engineered Castings Show in Cincinnati, May 6-10.

HOW TO MIX MOLDING SAND WITHOUT WATER

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Baroid Div.,
National Lead Co.,
Chicago

Waterless mix bonded with oil and bentone adhesive produces high quality castings

Certain disadvantages inherent to molding sands containing water have been eliminated by the development of waterless mixes utilizing a bentone adhesive and oil as the bonding agents. A variety of aluminum aircraft castings have been made in molds of this type. The castings were proved sound by x-ray inspection and had a finish of 100 to 150 micro inches. Other metals successfully cast have been brass, bronze, iron, nickel, and stainless steel.

In casting metals into a sand mold, the sand is commonly bonded with small amounts of clay moistened with water. Originally, sands containing naturally occurring clay were used. However, in recent decades molding sands are washed free of any clay or other contaminating material and specially selected clays are added back to it. The composition and use of such molding sands in the foundry art are well known.

Moisture A Problem

The properties of conventional molding sands such as have been described leave much to be desired, in spite of their wide and universal usage. Many problems arise from the fact that the properties of the conventional molding sand depend greatly upon their moisture content. Slight variations in moisture content can cause radical changes in their compressive strength, permeability, and flowability.

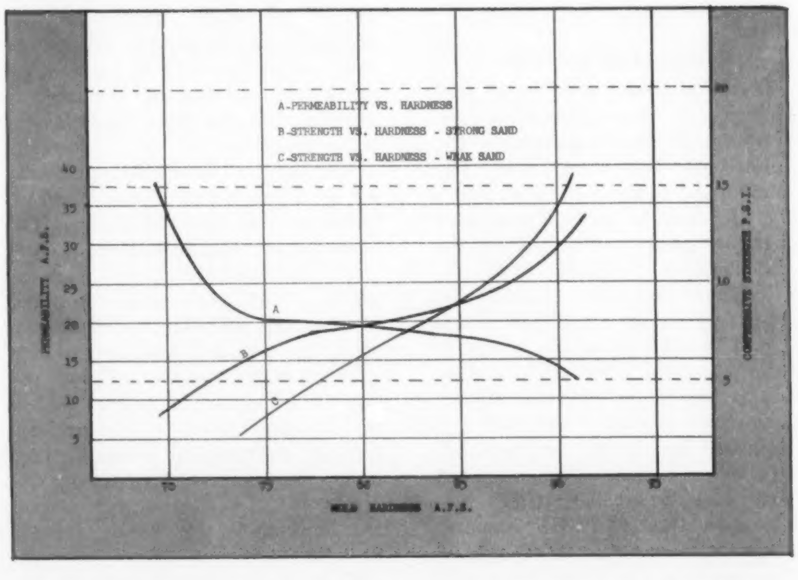
These changes, if uncorrected, will cause surface and interior defects in castings. The moisture content of molding sands can vary appreciably during pouring, working, or storing, as a result of evaporation losses. Very little can be done to prevent the evaporation of water because of its relatively low boiling temperature.

Conventional molding sands must be quite permeable, that is, must pass gas freely in order to accommodate the large volume of water vapor evolved when molten metal contacts the sand. Permeability is a function of pore diameter which, in turn, is a function of average sand particle size. This sets a definite lower limit on the fineness of sand which can be used in any particular type of casting. It is seldom possible to obtain as smooth a surface finish as desired when using conventional molding sands because very fine sand with low permeability cannot be used.

Another factor influencing the smoothness of surface finish is the adherence or bonding of sand particles to the metal, after the casting process has been completed. This quite common occurrence makes it necessary to clean castings by sand blasting, wire brushing and grinding. As a result a clean metal surface is presented by the casting, instead of one marred by sand grains and other tightly bonded residue removed from the face of the sand mold. This cleaning time is an expense which can be an appreciable portion of the total cost of the casting.

TABLE I. PROPERTIES OF BENTONE

Composition	Modified silicate
Specific gravity	1.80
Bulking value	15.0 lb/gal
Color	Very light cream
Ultimate particle size	Platelets: 0.05-1.0 micron by 0.002-0.004 micron thick
Fineness	Less than 5 per cent on 200 mesh sieve
Water content	Less than 3.0 per cent



Strong sand or weak, best castings are made with 80-85 mold hardness.

Water-Free Sands

To avoid the disadvantages of sands containing water, many waterfree molding sands have been tried in foundries over the years. These waterfree sands contained oil as a bonding agent. Oil was believed to be superior to water because it boiled at a higher temperature than water and evolved less gas, thereby requiring less sand control because of lower evaporation losses. The oil also caused less chilling of the molten metal. In spite of these advantages the oil-sand systems were always found to be impractical because of their very low strength.

To obtain the required strength in the absence of water, a bonding agent effective in oil was needed. Such a product was developed by the Baroid Division of the National

Lead Co. The new product is a dry powder and contains a mixture of heavy metal oxides and the modified silicate known as bentone.*

Bentone is produced by reacting sodium bentonite with an organic ammonium or onium salt to form an organic onium bentonite plus salt. Insolubility of the onium bentonite compound favors the reaction in the direction which forms more onium bentonite.

Bentone Research

Methods of using the new mixture most efficiently were investigated in an extensive research program conducted at the Armour Research Foundation in Chicago during the years 1954 and 1955.

This development was first introduced to the castings industry at the 1956 AFS Castings Show in Atlantic City where it attracted notable interest. The properties of bentone are shown in Table I.

The objective of this investigation was to determine the merits, if any, of using bentone in the formulation of green molding sand and dry core mixes.

A molding sand mix was derived from experimentation and has shown great promise. It consists of washed silica sand (130 gfn), bentone, iron oxide, coastal (C.R.) oil and catalyst. Aluminum, copper-base alloys and light weight gray iron castings have been successfully cast in this sand mix with exceptionally good results.

Field trials determined the average number of times the sand could be molded before additions of oil and bond were necessary. The superior quality of the castings was quite readily established in the laboratory and verified in the field.

With aluminum and brass casting the sand did not require rebonding or remulling before each use. Tests showed that a single riddling of the sand between uses sufficed for varying number of times. Conventional sand lab compressive strength tests were run. For a while it was felt that a drop in strength to an arbitrary minimum value would serve as an index of the sand's moldability, and signal when rebonding was necessary. Subsequent experience proved this was not the whole story. Mold hardness also proved a definite variable and factor. To date no definite test will predict when rebonding is necessary.

Experience indicates that rebonding through addition of oil alone and, in some cases, oil and bond is necessary. The rebonding cycle and its make-up are functions of two variables. The Btu input into the mold is one factor. High Btu input can affect the bentone as well as the oil. The higher the Btu input the sooner rebonding is necessary, and the more bentone as well as oil will be needed. Another factor is shakeout time. If the casting goes to shakeout before it has cooled below the flash point of the oil, burning will consume some of the oil in the sand. A longer shakeout time decreases oil consumption. The lower temperatures involved in non-ferrous casting minimize these problems.

Casting Benefits

After nearly four months of operation at one non-ferrous foundry the system was analyzed for cost. In the average day to day operation it was found that 2-1/2 lb. bentone per 100 lb. sand were required to maintain working green strength. This amounted to approximately $24.00 per day or $14.00 per day over the former water sand method. The results however, showed that one less man was needed for cleaning of the castings. Scrap castings were reduced to a minimum. Because of better appearance and dimensional tolerances higher prices were obtained for the castings. Tests showed that regardless of green strength of the sand, an average mold hardness of 80 to 85 was required to make the best castings.

Bentone bonded oil sands were used in the casting of aluminum. These castings ranged from small aircraft castings a few inches long and wide and quite thin, to large chunky castings six or more feet long and wide, and two to three feet thick. X-ray soundness was required of many, and a measured finish of 100 to 150 micro inches. Various brasses, both red and yellow, aluminum and silicon bronze, iron, nickel and even stainless steel castings were tried and techniques developed for them.

This article is the preprint of a paper entitled *"Oil-Bonded Molding Sand,"* which will be presented at a Sand session of the 1957 AFS Castings Congress and Engineered Castings Show in Cincinnati, May 6-10.

Aluminum aircraft parts were among first production castings to be made in oil and bentone bonded sand.

* Bentone is a registered trade mark of the Baroid Div. of the National Lead Co.

TIN IS NOT A SUBVERSIVE ELEMENT IN GRAY IRON

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D. E. Krause /
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H. W. Lownie, Jr. /
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Additions act as powerful stabilizer of pearlite, promoting wear resistance and machinability

Tin has in the past been almost universally regarded as an undesirable element in iron and steel, and has long been considered to have an inherent embrittling effect on gray cast iron.

Recent research by DeSy and Foulon[1] has suggested that the carbide-stabilizing effect of tin in gray iron can be used to advantage. The research reported here has shown that, by using tin judiciously, it is possible to promote fully pearlitic matrix microstructures in gray iron with a high degree of predictability and control. The pearlitic microstructure is highly desirable for many applications, especially those involving high resistance to wear combined with a need for good machinability.

Although the general effect of tin on the microstructure of gray iron had been established previously, little use has been made of tin as an alloying element in cast iron. The reluctance of the foundry industry to use tin as an alloying addition is probably partially the result of the erroneous belief that tin always causes brittleness, and partially the result of lack of familiarity with the beneficial effects of tin.

Information on the actual mechanical properties of cast irons containing small amounts of tin is needed before maximum use can be made of the carbide-stabilizing effects of tin. It was to fill this need that the present research was conducted.

The effect of tin was determined on the microstructure and on the common mechanical properties of the two common types of gray cast iron listed in Table I.

Experimental Procedure

The cast irons were melted in an electric induction furnace using a charge of pig iron and Armco iron punchings. Ferromanganese and ferrosilicon were

TABLE I. EFFECT OF TIN ON PROPERTIES OF GRAY IRON

	Automotive-Type Hypoeutectic Gray Iron	General-Purpose Hypereutectic Gray Iron
Pearlite in Microstructure of Base Iron, per cent	80 to 90	50 to 60
Tensile Strength of Base Iron in 1.2-Inch Bars, psi	31,500	16,000
Total Carbon, per cent	3.26	3.65
Silicon, per cent	2.01	2.44
Manganese, per cent	0.70	0.47
Sulfur, per cent	0.087	0.102
Phosphorous, per cent	0.108	0.079

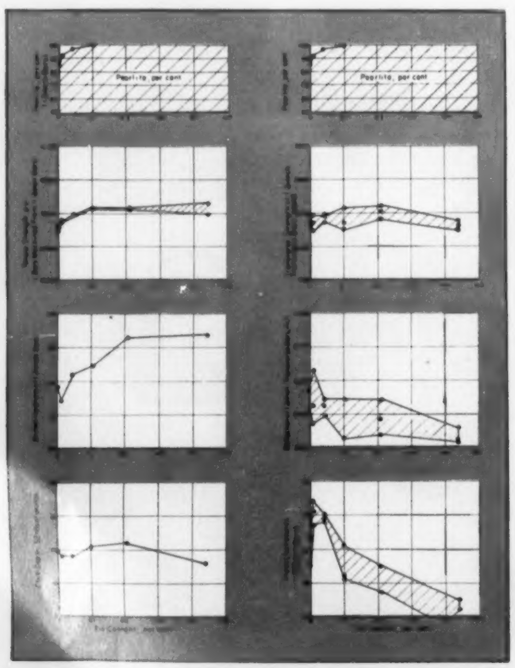


Fig. 1 . . Tin effects on hypoeutectic iron.

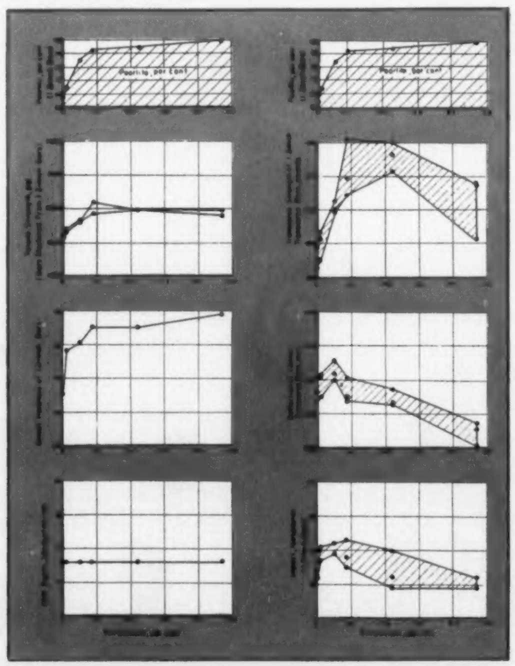


Fig. 2 . . Tin effects on hypereutectic iron.

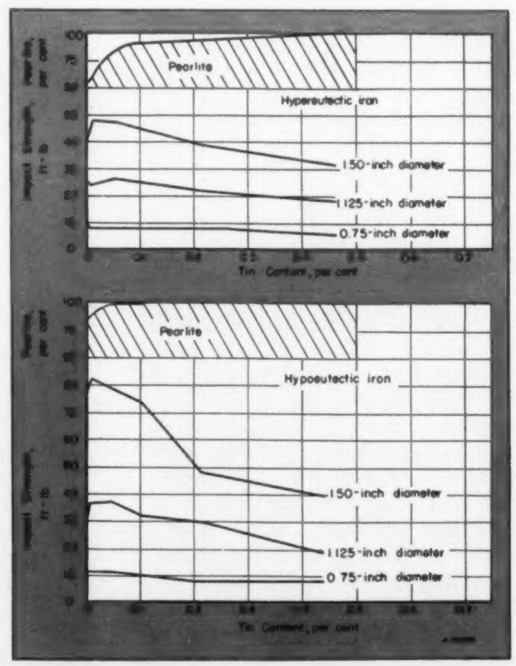


Fig. 3 . . Effect of tin on impact strength.

added to the molten cast iron to produce the desired composition. This practice gave residual contents of 0.001 or 0.003 per cent of tin in the base irons. Portions of each melt were treated with 0, 0.01, 0.05, 0.10, 0.25, or 0.50 per cent of tin. Tin was added as pure tin shot, and recoveries of tin by the iron were about 90 per cent. Each alloyed portion of iron was inoculated with 0.30 per cent silicon, added as ferrosilicon containing 70 per cent silicon. The late addition of silicon is included in the reported chemical analysis. The analyses for tin was by the wet method.[2]

The irons were superheated to 2700 F during melting, and the test castings were poured into green sand molds at 2550 F.

Mechanical Properties

The effects of tin on the mechanical properties of the hypoeutectic and the hypereutectic gray irons are shown in Fig. 1 and 2.

The chilling tendency was practically unaffected by tin contents up to 0.5 per cent.

With both irons, the Brinell hardness increased with increasing amounts of tin. The tensile strength in 1.2-inch bars increased with increasing amounts of tin up to about 0.10 per cent, and then leveled off as more tin was added. The deflection in the transverse test and the impact strength of unmachined 1.2-inch bars increased slightly when about 0.01 to 0.05 per cent of tin was added, and then fell off as still more tin was added.

There was a major difference in the effect of tin on the transverse strength of the two irons. The transverse strength of the automotive-type hypoeutectic iron was not affected by the tin content, while the transverse strength of the general-purpose hypereutectic iron was increased markedly up to a tin content of 0.1 to 0.2 per cent.

Because of special interest in the possible embrittling effect of tin in cast iron, the impact strength of tin-bearing irons was investigated in more detail. Test bars with as-cast diameters of 2.0, 1.2, and 0.875 inch were machined to diameters of 1.5, 1.125, and 0.75 inch, respectively, and tested for impact strength in the unnotched condition in a Charpy-type test. The results are shown in Fig. 3. Impact strengths increased slightly with very small amounts of tin, and then decreased gradually with increasing amounts of tin.

Two effects warrant special notice. First, in both types of irons and in all three sizes of test bars, the impact strength of iron containing 0.1 per cent tin was no lower than that of the base iron. Second, no deleterious effect of tin upon impact strength was experienced until after the tin had substantially eliminated massive ferrite from the microstructure and until tin was added in amounts in excess of those needed to produce an essentially pearlitic matrix. Tin, then, was embrittling, but only in amounts which exceeded those needed to obtain control of the microstructure.

A careful procedure involving the use of electric-resistance strain gages was used to study the effect of tin upon the stress-strain relationships in the two types of cast iron under study.

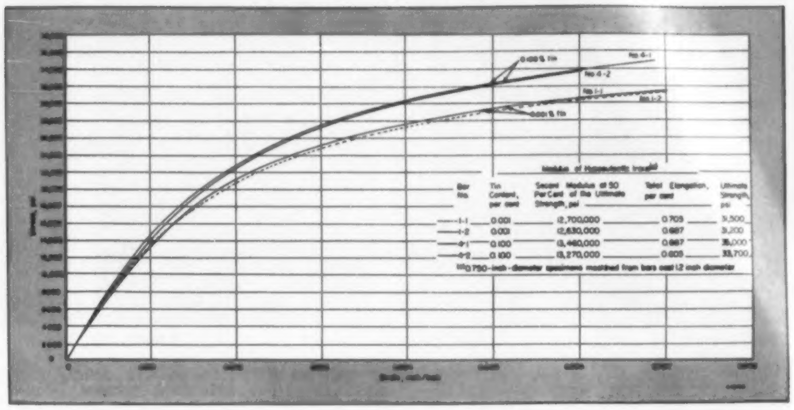


Fig. 4 . . Addition of 0.10 per cent tin to automotive-type iron increases modulus of elasticity, tensile strength and toughness.

For the automotive-type iron, Fig. 4 shows that 0.10 per cent of tin increased the modulus of elasticity by about 5 per cent, increased the tensile strength by about 10 per cent, and increased the toughness of the iron (the area under the stress-strain curve).

For the soft hypereutectic iron, 0.08 per cent of tin lowered the modulus of elasticity slightly (but not consistency) increased the tensile strength by about 16 per cent, and increased the toughness.

All of these effects on the stress-strain curve were small from a commercial viewpoint.

The current investigation has not included experiments on the effects of tin upon the wear resistance or machinability of gray iron. It is planned that such studies will be made.

Microstructure

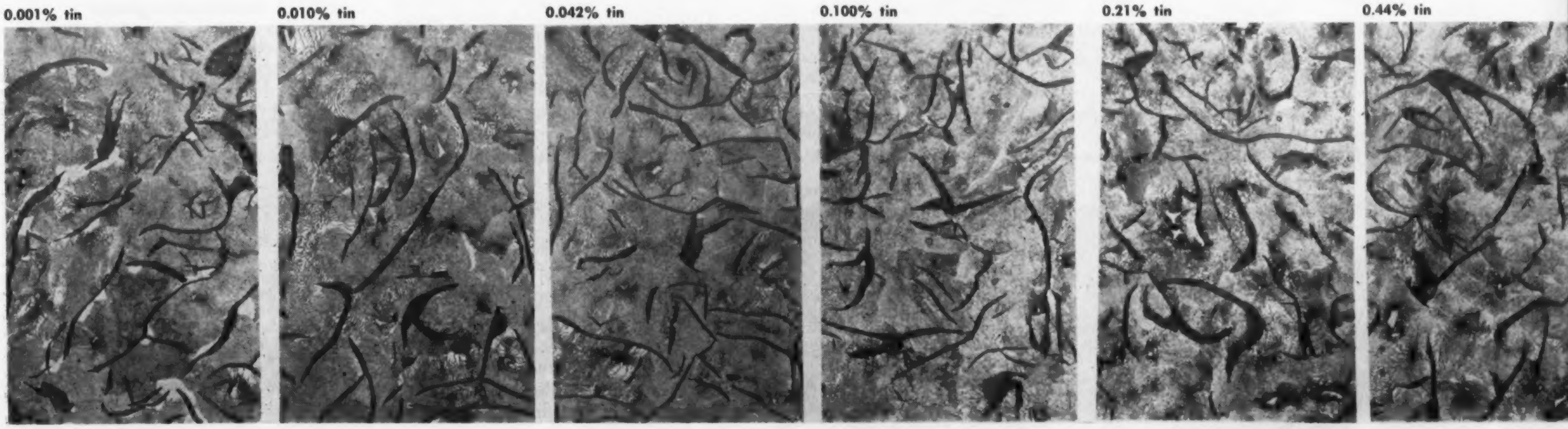
A small addition of tin is a powerful stabilizer of pearlite. The optimum amount of tin necessary to produce a fully pearlitic microstructure was governed by the microstructure of the base iron.

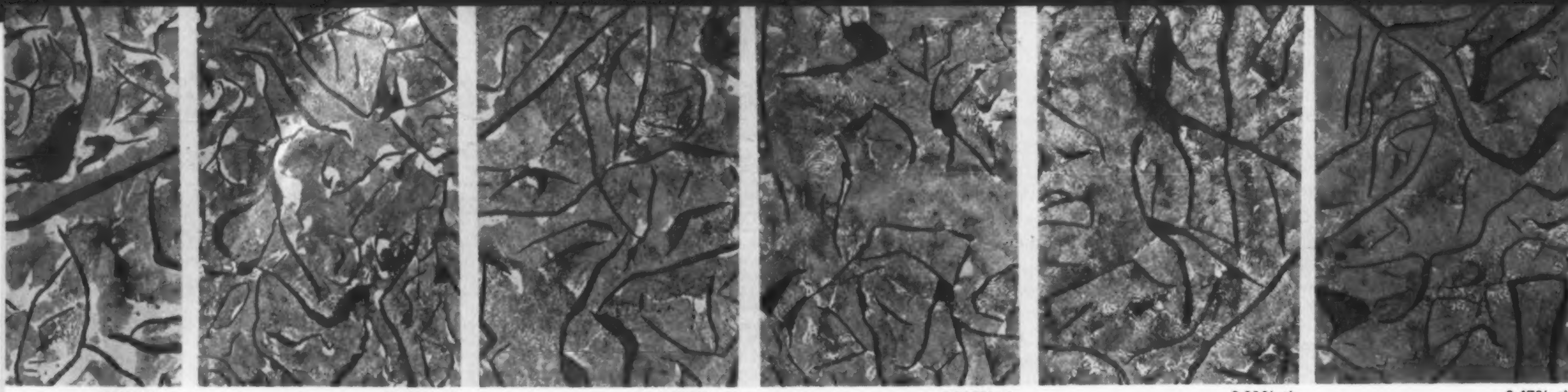
Fig. 5 shows how the pearlite in the microstructure of the hypoeutectic cast iron increased from about 80 per cent to about 100 per cent as tin increased to 0.10 per cent. Fig. 6 shows that about 0.5 per cent of tin was required to increase the amount of pearlite in the microstructure of a hypereutectic cast iron from about 50 per cent to about 100 per cent.

The microstructures shown in

Fig. 5 . . Pearlite in microstructure of hypoeutectic cast iron was increased from 80 to 100 per cent as amount of tin was increased to 0.10 per cent.

0.001% tin | 0.010% tin | 0.042% tin | 0.100% tin | 0.21% tin | 0.44% tin





0.003% tin | 0.010% tin | 0.049% tin | 0.087% tin | 0.21% tin | 0.47% tin

Fig. 6 . . About 0.5 per cent tin was required to increase the amount of pearlite in microstructure of hypereutectic cast iron from 50 to 100 per cent.

Fig. 5 and 6 were obtained in test bars 1.2 inch in diameter. Microstructures obtained in test bars either 0.875 inch or 2.0 inches in diameter showed about the same amounts of ferrite and pearlite as did the 1.2-inch bars of the same composition.

Alloying additions, such as chromium or vanadium, are often made to gray irons to stabilize pearlite. These additions have the undesirable feature that small excesses will cause massive iron carbides to appear in the microstructure. In contrast to this, reasonable excesses of tin did not promote the formation of massive iron carbides. For example, a tin addition of 4 or 5 times the optimum amount necessary to produce a fully pearlitic matrix did not result in massive carbides in the microstructures shown in Fig. 5.

As a complement to the laboratory investigation, the effect of tin on the microstructure and mechanical properties of gray iron was also determined in several commercial foundries. Additions of tin had about the same effect on mechanical properties and microstructures of commercial cast irons melted in cupolas as was obtained on irons cast and tested in the laboratory.

The effects of additions of tin on the microstructure of one cast iron are shown in Table II.

The amount of pearlite in the microstructure increased with increasing amounts of tin (Fig. 7).

The effect of tin upon the amount of pearlite in a gray iron is of particular commercial interest. Prior research has established that a completely pearlitic matrix is highly desirable for many applications because of its excellent combination of high machinability and good resistance to wear. Commercial applications which can profit from the beneficial properties of a fully pearlitic matrix include piston rings, cylinder liners, ways of machine tools, and many other specialized parts.

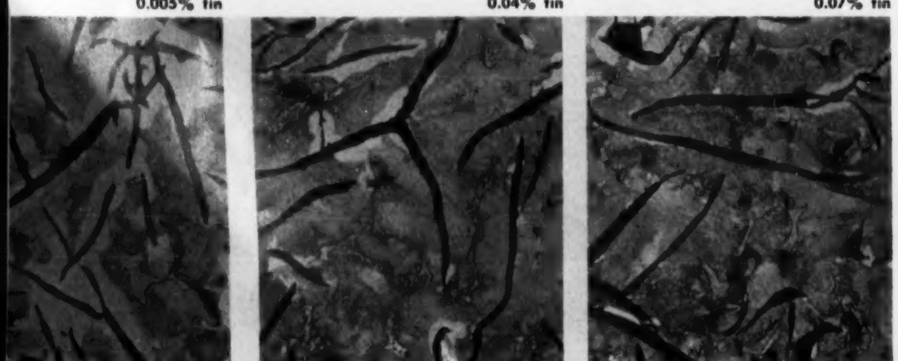
Although this paper is not intended to deal with the effect of tin in nodular iron, it is pertinent to remark that the effect of tin in nodular iron is similar to its effect in gray iron. Additions of about 0.05 per cent of tin have been found to be effective in removing all traces of ferritic "bulls-eye" structures from even heavy sections of pearlitic nodular iron. The subversive effect of tin on the nodulizing behavior was overcome with a small addition of rare earths, and the result was completely pearlitic matrix structures with small well-formed nodules of graphite.

TABLE II. EFFECT OF TIN ON MICROSTRUCTURE

Bar	Tin Added, per cent	Chemical Composition, per cent					
		Sn	T. C.	Si	Mn	P	S
407	0	0.005	3.73	2.69	0.58	0.477	0.10
408	0.05	0.04	3.71	2.74	0.56	0.463	0.092
409	0.10	0.07	3.66	2.77	0.56	0.464	0.088

Fig. 7 . . Effect of tin on amount of pearlite in commercial cast iron.

0.005% tin | 0.04% tin | 0.07% tin



Summary

Investigations on cast irons melted in a laboratory and on irons melted in cupolas in commercial foundries have shown that additions of tin had a powerful stabilizing effect on the pearlite in the microstructure of both automotive-type hypoeutectic irons and general-purpose hypereutectic irons. Although the additions of tin acted as a powerful stabilizer of pearlite, tin did not show the objectionable tendency to promote chill depth as exhibited by other alloys commonly used to stabilize pearlite in gray iron. Also on the favorable side, a substantial excess of tin did not cause massive iron carbides to form in the matrix, as is commonly experienced with some other alloying additions used to stabilize pearlite.

The optimum amount of tin necessary to produce a completely pearlitic microstructure was governed by the amount of ferrite in the base iron before the tin was added. The mechanical properties of the irons were improved slightly with increasing amounts of tin up to about 0.05 to 0.10 per cent, and fell off slightly at higher tin contents in both types of iron. A general-purpose hypereutectic iron still contained a small amount of ferrite, but an automotive-type hypoeutectic iron was completely pearlitic in this range of tin contents.

In all cases, tin contents of 0.10 per cent or less resulted in slightly improved mechanical properties without producing any undesirable properties. No embrittling effects of tin were found at levels up to 0.10 per cent, and it is in this range that tin had its major beneficial effects upon microstructure and mechanical properties.

Further research is being conducted on (1) a direct comparison of the effects of tin with the effects of several common carbide-stabilizing additions, (2) the effect of tin on machinability, and (3) the effect of tin on properties of commercial castings where control of the amount of pearlite is important.

Acknowledgment

This paper is based upon research sponsored by the Tin Research Institute, Inc., whose permission to publish these results is gratefully acknowledged.

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(2) Lundell, Hoffman, and Bright, *Chemical Analyses of Iron and Steel*, John Wiley and Sons (1931), pp 383-385.

This article is the preprint of a paper entitled "*Tin as a Useful Alloy in Gray Iron*," which will be presented at a Gray Iron session of the 1957 AFS Castings Congress and Engineered Castings Show in Cincinnati, May 6-10.

CALIFORNIA REGIONAL FEATURES RANGE OF TECHNICAL SUBJECTS

Over 450 foundrymen turned out for the Berkley program featuring an all-inclusive program of technical papers

J. H. Schaum / *Editor*

A broad program of discussion on foundry technology being carried on within view of San Francisco Bay proved an attraction strong enough to draw 450 foundrymen to the Hotel Claremont, Berkeley, Calif., for the AFS California Regional Foundry Conference, March 15 and 16.

General Chairman Charles R. Marshal, Industrial & Foundry Supply Co., Oakland, Calif., and his committeemen presented an program that mitteemen presented a program that included speakers from such far away places as New Jersey, Ohio, and Missouri as well as a good representation of West Coast talent. A well balanced variety of subjects to appeal to all foundry interests included air pollution, apprentice and college education, aluminum, coke, gating and risering, safety, European practices, steel, scrap control, vacuum melting and casting, and shell molding.

AFS President Frank W. Shipley was an honored guest at the Friday night banquet.

The principal speaker after the banquet was Prof. Gilbert S. Schaller, University of Washington, Seattle, Wash. Prof. Schaller related some of the observations made in European foundries during a trip last summer to the International Foundry Conference in Duesseldorf. According to the speaker the CO_2 process is being used extensively in Britain and Germany. One foundry has abandoned the use of core ovens entirely, another heats CO_2 treated cores to increase their strength, while another Frischkorn in Isselburg adds an oil to the sand mix to overcome shakeout difficulties.

Following the lead taken by Los Angeles, San Francisco is now becoming aware of air pollution problems in the bay area. Benjamin Linsky has been engaged by the Bay Area Air Pollution Control District to serve as Air Pollution Control Officer. Linsky acquainted the foundrymen with the problem of air pollution in the area. A temperature inversion phenomena, resulting from the unusual water and land masses, traps the undesirable industrial emissions so that they build up to objectionable concentrations. Open dump burning is as big a contributor to air pollution as is industry. Many industries have been forced to leave the bay area because their product is susceptible to damage from air pollutants.

"Education—Foundry Educational Foundation — Apprenticeship" were combined into one panel discussion because of their similar goals and problems. Clayton D. Russell, Phoenix Iron Works, outlined the apprentice training program that he has spearheaded as chairman of the AFS chapter apprentice training committee. Only 20 journeyman molders are being currently trained when the area has need for at least 40. According to M. C. Sandes, Division of Apprenticeship Standards for California, the quality of apprentices is improving but not the quantity. Prof. James S. Campbell, University of California, described the goals of the Foundry Educational Foundation and demonstrated the success of the program by introducing two of his F.E.F. students who told of their experiences during summer foundry employment.

With the aircraft industry heavily concentrated in California, interest ran high at the session on *"Modern Aluminum Alloys and their Applications in the Foundry"* addressed by Walter Bonsack, Jobbins Co., Los Angeles. Properties of aluminum castings are being improved by the introduction of the new high purity Al-Si-Mg alloys, 355 and 356.

Of fundamental interest to all gray iron foundrymen was the talk on *"Coke and Its Relation to Cupola Operation"* presented jointly by J. W. Rendall and M. R. Gallo, Great Lakes Carbon Corp., St. Louis. Coke in the cupola performs three functions. It furnishes the fuel for heat, carbon to the molten iron, and supports the charge. For good control the cupola bed height should be maintained constant. The color of smoke emission from the stack is a reliable indicator of the bed conditions. If the smoke is brown, the bed is falling; buff colored smoke indicates a rising bed; white smoke is desirable because it shows the bed is staying constant.

The Emerald Room was packed when the grand-old-man of the West Coast foundry industry, Dominic Coccione, Washington Iron Works, Seattle, Wash., revealed his 49 years of experiences in *"Gating for Pressure Casting and Economical Molding Pra tice."* In his inimitable "southern accent" the speaker described the rigging practices needed to make acceptable pressure tight castings. Castings are poured fast, 225 lb. per second in some instances, inorder to prevent skin formation on cold mold walls. With the aid of a number of slides, he demonstrated the importance of his company's practice of photographing every operation in molding and pouring. A year later when a similar casting has to be made they do not have to depend on memory as a guide to correct procedures.

Among the sheltering palms were, left to right, AFS President Frank W. Shipley, Prof. G. S. Schaller, University of Washington, and Harold E. Henderson, president, AFS Northern California Chapter.

F. H. Kobely, Columbia-Geneva Steel Div., U. S. Steel Corp., San Francisco, arranged the showing of a color sound film on the subject of safety. The film was entitled *"Knowing's Not Enough."*

The fellowship hour preceding the banquet revealed the presence of over 75 ladies who had accompanied their husbands to the conference. Miss Riki Lipe, beautiful, auburn-hair model, who appeared in a pre-conference publicity photo (see February Modern Castings, 33) was present. Much to the surprise of Jay Snyder, conference publicity chairman, Riki proved to be the bonafide daughter-in-law of foundryman A. C. Axford, Mission Foundry & Stove Works, San Francisco.

The subject of steel casting was given excellent treatment by Hubert Chappie, National Supply Co., Torrance, Calif., in a talk which had the longest title of the Conference—*"What Occurs After the Mold is Made Until it is Poured, Can Effect the Cleaning Cost."* The speaker emphasized the importance of good molding, drying,

handling, closing, and pouring as a necessary adjunct to a good sand mix for making quality steel castings. Cleaning room costs can be markedly reduced by (1) thorough drying of molds and cores, (2) pouring the molten steel into the mold rapidly and as cold as feasible, and (3) avoiding the use of cores that have been made too far ahead of time.

Although designated as a Brass and Bronze Session the talk given on *"Scrap Control Procedures for Foundries"* by Martin G. Dietl, Burndy Engineering Co., Lynwood, Calif., was good advice for any foundryman. The importance of developing a "job history card" for each casting job and the intrinsic values to be gained from use of this information were described. Success of any scrap reduction program needs the full support of top management. They must be willing to hire a man capable of setting up such a record system and then putting it to practical use in daily production. Scrap reduction can actually start on the drawing board of the design engineer who should confer with the foremen of the pattern shop, core room, and foundry before deciding on a final casting design.

Foundrymen were stimulated to do some long range thinking into the future by Charles d'A. Hunt, Temescal Metallurgical Corp., Richmond, Calif., speaking about high vacuum casting. The equipment requirements for vacuum melting and casting were described in terms of cost and metallurgical properties attained.

In Germany, mechanical pumps are being used to remove hydrogen from steel with pressures of -29 inches of mercury. By supplementing a mechanical pump with an oil diffusion booster, pressures below one micron are attainable. At this low pressure all the CO and part of the N can be removed from metal such as titanium. At 0.1 micron pressure, all the N , S, and P can be removed from copper. The electrical conductivity of this copper is much better than that of the OFHC grade. Advantage of this superior conductivity is required in Klystron tubes and users are willing to pay for the high-cost vacuum melted material.

For the most part it is military demands that are being met by these expensive super grades of metals. Mold materials for casting in vacuum have presented a challenging problem. Resin-bonded refractories have been unsatisfactory but high-grade graphite molds have been meeting the stringent requirements. Since all the extraneous deleterious influences associated with normal melting are eliminated in vacuum, the properties of castings are unusually uniform from heat to heat.

No well rounded foundry program is complete without a good talk on shell molding. At the California Regional this spot was filled by J. L. Stark, Barrett Div., Allied Chemical & Dye Corp., Edgewater, N. J. The speaker touched briefly but yet thoroughly on solutions to most common problems that face foundries producing castings by the shell molding and blowing process. A complete cost analysis should be run on the casting under consideration before expenditure of hard cash on an expensive pattern. A pilot operation should then follow and serve to further evaluate the technical and economic problems.

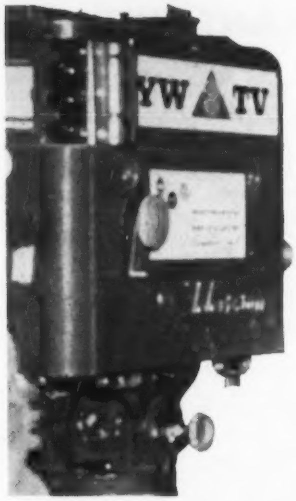
Coating of sands by both cold and hot process was described. Selection of sand is important. It should have a wide distribution over three or four adjacent screens. Present trends are toward blending of washed silica sand with bank sands and also toward using coarser sands. Sands with AFS fineness no. 50-60 are now being used while a few years ago sands of 100-150 gfn were popular. The coarser sands still give good finish.

No subject cuts through all foundrymen's interests quite so completely as that of *"Gating and Risering"* and no speaker is better qualified to discuss this subject than Harold F. Bishop, Exomet, Inc., Conneaut, Ohio. Experiences of 15 years research activity at the Naval Research Laboratory guided the speaker in this informative session. Riser feeding range can be extended as much as 300 per cent by judicious employment of chills. Steel chills placed at extremities of castings speed the flow of heat from the solidifying casting thereby decreasing the time that a riser must stay fluid to satisfy shrinkage demands. Copper and water cooled chills do not contribute enough additional benefits to merit their expense. Riser diameter is governed not only by section thickness to be fed but also by the geometry of the casting. Where a 4-in. cube-shaped casting can be fed by a 4-1/2-in. diameter riser; a 4-in. plate requires a 10-in. diameter riser. Short, thick risers are more efficient than long, thin ones. If a metal has a wide solidification range it is more difficult to feed than one of eutectic or near-eutectic composition.

Feeding efficiency of risers can be further improved by reducing heat loss. Insulating materials around and on top of the riser keep it fluid longer. Further improvement results if exothermic materials are used since they actually add heat to the riser. Casting yields exceeding 90 per cent can be obtained by proper application of chills on the casting and exothermic materials around risers.

Harry H. Kessler, Sorbo-Mat Process Engineers, St. Louis, asked local foundrymen to bring scrap castings to his session on *"Foundry Problems"*. After an intense search a few such castings were located in the Bay area. One casting defect was attributed to rough handling and shaking out too hot. High pressures in machine molding coupled with flasks not built sturdy will often give distorted castings. The speaker has found that cast iron plate-type castings are better poured downhill. Certain shell mold defects can be cured by adding fuller's earth or fuel oil to the sand.

Deep conversation at the dinner table included, left to right, AFS Director B. G. Emmett, Chapter President Harold E. Henderson, and John R. Russo, a nominee for election as a national director of AFS.

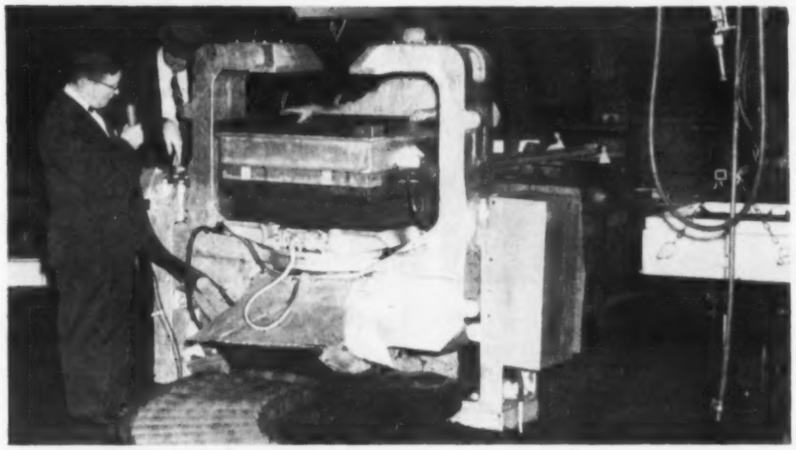


TV
GOES TO A FOUNDRY

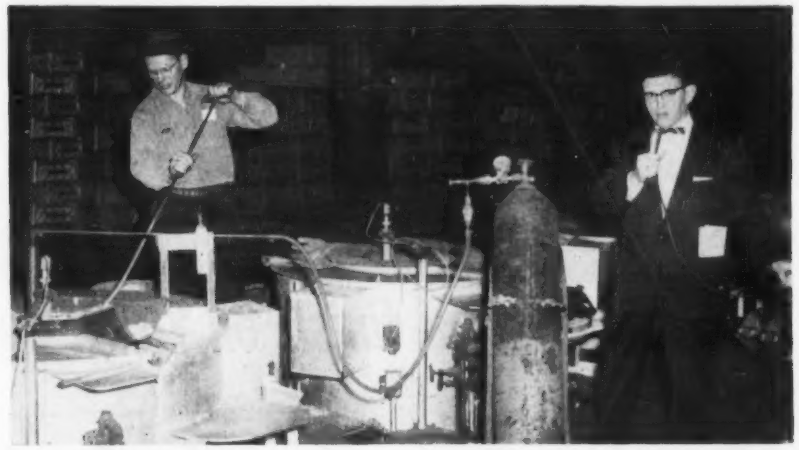
Camera dollies and mike booms have become part of the tool kit used by the Educational Committee of the Northeastern Ohio Chapter of AFS to publicize the castings industry. The chapter has twice arranged television programs on Cleveland station KYW as part of a "Science Adventures" series. This year's program on "Light Metal Casting" originated live from the Aluminum Co. of America's Cleveland Works Division.

The 1956 performance received the highest audience rating of any show in the series and this year's program resulted in several hundred requests for the AFS publication THE FOUNDRY IS A GOOD PLACE TO WORK which was offered free to viewers.

The cast for the show was made up of Alcoa personnel and other aluminum foundrymen in the Cleveland area. Plans were prepared by the chapter educational committee, Emil J. Romans, chairman, and by a sub-committee including A. H. Hinton, Aluminum Co. of America; Lon Ulsenheimer, National Malleable & Steel Castings Co.; and Henry Apthorp, East Ohio Gas Co.

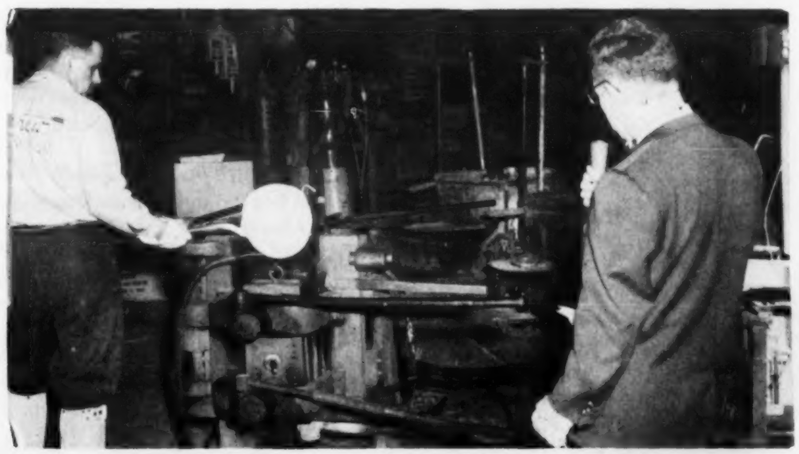


Sand mold on jolt rollover machine was made by Alcoa sand foundry foreman Emmett Webster. Program announcer is Dr. Carl Ludeke, of the University of Cincinnati, who acts as host for these shows.



Ready to ladle metal from the pot is Leo Baboryk, another Alcoa foreman. A kinescope of this program is now being shown in the Cleveland area high schools by the Northeastern Ohio AFS Chapter.

Assembling the plaster mold for an aluminum impeller is Bill Walters, plaster department foreman, and TV star-for-a-day on this program planned to emphasize the foundry's contribution to everyday living.



Carl Bush, Arrow Aluminum Castings Co., pours aluminum into a permanent mold for an engine crankcase to show viewers a final step in producing the many and vital products of the castings industry.

PLANT VISITS

21 Plants Schedule Open Houses For Castings Congress Visitors

Twenty-one foundries in the Cincinnati area will be available for inspection by visiting foundrymen during the AFS Castings Conference. All arrangements have been made by the Cincinnati Chapters Plant Visitation Committee, M. E. Rollman, Cincinnati Milling Machine Co., chiarman.

Cincinnati

Buckeye Foundry Co., 2800 Beekman St. Sand-cast gray iron jobbing. Heavy machine tool, machinery grade castings in semi-steel, alloys. Pattern and machine shop.

Cincinnati Milling Machine Co., 4701 Marburg Ave. Large captive, sand-cast gray iron shop. Machine tool, general machinery castings. Shell molding, heat treating, machine shop, laboratory, grinding wheel division.

Griffin Wheel Co., 5300 Vine St. Sand-cast captive gray iron foundry.

Oakley Pattern & Foundry Co., 4423 Verne Ave. Sand-cast jobbing shop, aluminum, brass and bronze. Foundry and pattern shop.

Oberhelman-Ritter Foundry Co., 3323 Colerain Ave. Sand-cast gray iron jobbing plant. Ductile iron, machine tool castings.

O.P.W. Corp., 2730 Spring Grove Ave. Sand-cast captive shop, aluminum, brass and bronze, monel. Machine shop, pattern shop.

Wm. Powell Co., 2525 Spring Grove Ave. Sand-cast captive non-ferrous foundry: aluminum, brass and bronze, monel, pure nickel, nickel bronzes. Foundry and laboratory.

Reliance Foundry Co., 500-526 E. Front St. Sand-cast gray iron shop, castings to 400 lb. Foundry, core department, cleaning department, related operations.

Sawbrook Steel Castings Co., Shepherd Ave., Lockland. Sand-cast jobbing steel foundry. Shell molding, centrifugal casting. Foundry, pattern shop, laboratory.

R. A. Taft Sanitary Engineering Center, U. S. Public Health Service, 4676 Columbia Parkway. Research on engineering and physical science aspects of air pollution problem.

Dayton, Ohio

Advance Foundry Co., 107 Seminary Ave. Machine tool, miscellaneous cast-

ings. Foundry, machine shop, commercial pattern shop.

Dayton Casting Co., Kiser & Capel Sts. Sand-cast jobbing, gray iron, ductile iron foundry. Power transmission, machinery grade castings to 50,000 lb. Sand and spectrographic laboratory, heat treating, machine shop.

G.H.R. Foundry Div. of Dayton Malleable Iron Co., 400 Detrick St. Sand-cast jobbing gray iron foundry. Light gray iron, automotive, refrigeration castings. Shell molding, heat treating.

Hamilton, Ohio

H. P. Deuscher Co., 7th & Hanover Sts. Sand-cast jobbing gray iron, ductile iron, alloy iron foundry. Machine tool, general industry castings. Foundry sand and metallurgical laboratory.

Hamilton Brass & Alum. Castings Co. 8th & Chestnut Sts. Jobbing nonferrous foundry, aluminum, brass and bronze, nickel alloys. Sand casting, permanent mold, centrifugal casting. CO_2 process.

Hamilton Foundry & Machine Co., 1551 Lincoln Ave. Open May 6 and 7; 9 and 10. Sand-cast jobbing foundry. Gray iron, ductile iron, Meehanite, Ni-resist, Ni-hard castings. Machine tool, diesel, compressor, and machinery castings, thin section or light. Magnaflux and Magnaglow. Commercial pattern shop, sand test and photomicrographic laboratory, heat testing.

Black-Clawson Co., Second & Vine Sts. Sand-cast jobbing-captive foundry. Gray iron, ductile iron, brass and bronze. Foundry, pattern shop, laboratory, machine shop.

Middletown, Ohio

Black-Clawson Co., Keuthan Foundry Div., 1700 Grand Blvd. Sand-cast jobbing-captive foundry. Gray and ductile iron.

Indianapolis

International Harvester Co., Truck Engine Works, 5565 Brookville Road. Captive gray iron shop. Sand casting, shell cores. Engine blocks, accessory parts. Foundry, pattern shop, machine shop, laboratory.

Link-Belt Co., Ewart Plant, 220 S. Belmont Ave. Captive sand-cast and shell mold malleable foundry, small parts. Foundry, pattern shop, machine shop, laboratory. Chain and conveyor assembly.

Louisville, Ky.

International Harvester Co., Crittenden Drive. Sand-cast captive gray iron foundry. Diaphragm molding operation, shell cores. Foundry and pattern shop. Sand reclamation.

Foundrymen Can Teach Youth Through New JETS Program

■ Foundrymen concerned with the problem of encouraging young people to enter the study of engineering so that trained personnel will be available to advance the technology of their industry, are invited to try JETS assistance.

JETS is a Junior Engineering Technical Society, with local clubs sponsored by local high schools throughout the nation and assisted by JETS headquarters, Michigan State University. Members are boys and girls interested in finding out whether they have the abilities necessary to meet the requirements of the engineering profession.

Members explore engineering and its different branches to discover which field most interests them. The local club members select and work on projects, either singly or as a group, with the assistance of local engineer who acts as an advisor.

Harold P. Skamser, director of the national program, states that JETS is a means of getting the "word" about engineering opportunities and requirements to high school students. Through the organization, students learn early in their career the necessity of mathematics, science, and other courses required to enter engineering schools.

Since its founding in 1950, the movement has spread into 30 states and two foreign countries. It has over 177 local clubs.

Foundrymen can assist local JETS clubs by presenting talks on their industry to the groups, by inviting local clubs to tour foundries, or by assisting in other ways that may be detailed by contacting JETS, Box 470, East Lansing, Mich.

Management Course at University of Iowa

The College of Engineering, State University of Iowa, has announced that it will hold its 18th annual summer course in management June 10-22 in Iowa City.

In addition to an intensive course of instruction, the classes will include a series of talks by recognized authorities on new developments, and problems in management techniques. The program is designed for factory managers, foremen, industrial engineers, cost men, and others in related work.

Communications regarding the course should be sent to J. W. Deegan, 122 Engineering Building, Iowa City, Iowa.

1957 International Foundry Congress Features Scandinavian Science, Scenery

■ The 24th International Foundry Congress, to be held August 19-24 in Stockholm, capital of Sweden, will combine the traditional elements of all European "Internationals"; technical sessions, extensive plant tours, ladies events, sightseeing and social functions. Organized by the foundry associations of Sweden, Norway, Denmark and Finland, the Swedish group will act as "hosts" for hundreds of visitors from many countries.

Technical papers from a score of countries have been scheduled from as far distant as Japan. Subjects include ductile iron, CO_2 developments, plastic core materials, hot-blast cupola balance, aging of cast light metals, iron oxidation, carbon pick-up, foundry health and ventilation, hot tear investigations, high-test malleable, and molding sand practice.

These world events are sponsored and scheduled by the International Committee of Foundry Technical Associations, comprising technical foundry groups in 17 countries. In America, AFS is the sole member. Presiding in 1957 will be the International President, Dr. A. B. Everest of London, England. General Secretary of the Congress is Lars Villner of Stockholm.

Three U. S. exchange papers have been scheduled. The "official" exchange, by H. W. Dietert, AFS vice-president, will cover *"Automatic Moisture Control in Foundry Sand."* A second paper describing American development in use of plastics as core box materials is by Richard L. Olson, Dike-O-Seal, Inc., Chicago, which the author will present in person. The third, by H. J. Weber, AFS director of Safety, Hygiene and Air Pollution, is on *"The Foundry Environment."*

The official opening ceremony takes place Monday, August 19, with a lecture on *"Theory and Experience"* by Prof. Erik Rudberg, Swedish Institure on *"Theory and Experience"* by sessions are scheduled all day Wednesday and Friday, organized plant tours on Tuesday and Thursday. On the final day the International Award of Honor, donated by Mario Olivo of Italy, will be presented.

Other events include a banquet and visits to art shows and museums.

An extensive list of modern foundry plants will be open to visitors. Organized works tours are scheduled for August 20 and 22. The first day includes seven separate tours; one to Finland, six in Sweden:

(1) Finnish iron and light metals foundry, one of largest in Scandinavia, 18,000 metric tons per year, highly mechanized; in Sweden: (2) modern, highly mechanized cast iron, copper alloys, light metals foundry, 10,000 tons; (3) modern steel foundry, 12,000 tons; (4) medium-size steel foundry, 3500 tons, austenitic manganese.

Also in Sweden: (5) modern iron foundry, 4000 tons, hot-blast cupola, low frequency furnace; (6) light metals plant, 800 tons, sand and die cast, automatic molding; also a copper alloy foundry of 400 tons with modern ventilation and induction melting; (7) tube foundry, 25,000 tons annual, centrifugal cast pressure and soil pipe, hot blast and low frequency melting.

Five separate study tours to plants in Sweden will be available on August 22:

(1) SKF plant, large modern iron and steel foundry, 17,000 metric tons yearly; also 3000-ton iron foundry, machine and thin-wall castings; (2) largest malleable in Sweden, with mechanized molding, hot-blast cupolas, reverberatory furnaces; (3) mechanized iron foundry, 9000 tons, motor and tractor parts; (4) copper-base and light alloys jobbing foundry, 1000 tons, sand and gravity die casting; (5) modern iron foundry, 5000 tons of iron rolls, 15,000 tons centrifugal-cast iron pipe.

Exchange papers of the Congress will be summarized in English, French and German. Preprints will be mailed to registered participants, but printed only in the language in which received. Non-participants may purchase preprints direct from the Swedish association, Sveriges Mekanforbund, Karlavagen 43, Stockholm 0, Sweden.

Notify Plans to AFS

AFS is learning the names of all American foundrymen planning to attend the Stockholm meeting. Notify the Secretary at the Central Office, Des Plaines, Ill. Because of limited accommodations, hotel rooms in Stockholm cannot be guaranteed after April by the Swedish association.

International visitors will take an excursion on these steamers and will attend a midnight concert at the National Museum, left.

foundry trade news

National Malleable and Steel Castings Co. . . has reported that sales for 1956 set a new record of $65,-233,000, and that its earnings of $3,826,000 were 60 per cent above 1955. Company president C. H. Pomery also announced the purchase of land in the Lake Superior iron ore area as the future site of plant to cast grinding balls for the taconite processing industry.

Birdsboro Steel Foundry and Machine Co. . . had a record year in 1956 with net sales over $19 million and net income of $770,000. Current order backlog is over $22 million.

Ford Motor Co. . . has announced that its new Edsel line will be assembled in plants at Mahwah, N. J.; Somerville, Mass.; Wayne, Mich.; Louisville, Ky.; and Milpitas, Calif. An additional plant will be selected in the Los Angeles area.

General Steel Castings Corp. . . earned $3,149,874 in 1956 on sales of $48,214,874. Company president C. P. Whitehead states that demand for company products will be sufficient to generate increased sales and satisfactory earnings in 1957.

American Machine & Foundry Co. . . earned a record $8,621,000 in 1956 on sales and rentals of $198,958,000. Unfilled orders at year end were over $85 million.

Allis-Chalmers Mfg. Co. . . set a company safety record in its 13 U. S. plants during 1956. Workers lost 264 days per million man hours worked during the year.

Ellicott Machine Corp. . . has acquired a controling interest in the McConway & Torley Corp., Pittsburgh, Pa., and its wholly owned subsidiary, Baltimore Foundry and Machine Corp., Baltimore.

Blaw-Knox Co. . . has announced a scholarship program for children of its employees. The program provides an annual grant of four scholarships for four years' study in engineering or science. Each award provides $1,000 per year for the student and a $500 grant-in-aid to the school. Universities selected for the program are Carnegie Tech, Pittsburgh, Lehigh, and Purdue.

Exports of copper scrap and copper-base alloy scrap have been placed under open-end licensing by the U. S. Department of Commerce. Under this arrangement, no limit is set on the amount of scrap that will be licensed for export, but surveillance will be maintained. Reason for relaxing controls is said to be improved scrap supply.

Link-Belt Co. . . will build a new $5 million bearing plant in Indianapolis to replace its present Dodge bearing plant. New operation is the second Link-Belt expansion in Indianapolis within a year. A new malleable foundry at the Ewart plant is expected to be completed before the end of 1957.

Lester-Phoenix, Inc. . . has announced the opening of a plant in Cleveland for machining operations on injection molding machines and die casting machines.

Interlake Iron Corp. . . has announced 1956 revenue totaling $110,153,114 and net profit of over $8 million.

American Smelting and Refining Co. . . is expanding its central non-ferrous metal research laboratories at South Plainfield, N. J. Lab space will be increased by 20,000 sq ft.

Climax Molybdenum Co. . . had consolidated earnings of over $15 million for 1956. For the first time, earnings include those of Climax Uranium Co.

National Metal Abrasive Co. . . increased first quarter shipments 30 per cent over last year. D. E. Neustadt, vice-president of the firm, reports that sales were aided by an "extensive, unsolicited survey and report by one of America's leading research societies." Sales of National Metal Abrasive are handled exclusively by Hickman, Williams and Co.

Electro Metallurgical Co. . . Union Carbon and Carbide division has completed a major air pollution abatement program at its lime kiln installation at Niagara Falls, N. Y. An investment of several millions dollars was required for the project.

Shallway Corp. . . shell molding equipment distributor has established a used equipment division with headquarters at its Connellsville, Pa., plant.

Electro Refractories & Abrasives Corp. . . will spend $157,000 for expansion and modernization of its Buffalo and Canadian plants. A 95-ft automatically controlled continuous tunnel kiln, to fire large crucibles and retorts, has just been placed in operation at the firm's Buffalo plant.

Vanadium Corp of America . . has opened a new pilot plant combining modern laboratory research with practical operating conditions at Cambridge, Ohio. The new pilot plant, which is part of the corporation's Research Center, permits sinmuation of actual operating plant conditions and allows preliminary trials to be made which are comparable to commercial practices.

Syracuse Fire Brick Supply Co. . . has been named exclusive distributor for National Crucible Co. in portions of New York, northern Pennsylvania, and western New England.

Link-Belt Co. . . reports 1956 sales of nearly $164 million, highest in its history.

International Nickel Co. of Canada, Ltd. . . set new records in earnings and ore production in 1956. Net earnings were over $96 million. Nickel deliveries were 286 million pounds and copper deliveries were 271 million lb.

Air Reduction Sales Co. . . will build a multi-million dollar air liquefaction plant at Acton, Mass., near Boston.

Monsanto Chemical Co. . . has started production of polymerized ethyl silicate at its Everett, Mass., Inorganic Chemicals Division plant.

Vesuvius Crucible Co. . . has announced the establishment of two undergraduate scholarships in ceram-

ic engineering at Pennsylvania State University. Each scholarship provides $500 annually.

Norton Co. . . the firm's Grinding Machine Division recently won safety awards from the Massachusetts Safety Council and the National Safety Council for its 1956 record among heavy machine builders.

Cerro de Pasco Corp. . . has opened a $25 million hydroelectric plant in Peru to provide service to the firm's non-ferrous mining operations.

Fred W. Fuller Co. . . Cleveland foundry equipment sales organization has been appointed sales representative for the Herman Pneumatic Machine Co., Pittsburgh, Pa. A new office will be opened in Cincinnati to aid in servicing the firm's territory which will include the entire state of Ohio, excluding the Toledo area.

Baker-Raulang Co. . . has named Ortmeier Machinery Co., Chattanooga, Tenn.; Peffen Machine Co., Nashville, Tenn.; and Dempster Machine Co., Knoxville, Tenn., as dealers for its fork trucks.

Norton Co. . . has established two new district offices, one in Atlanta, Ga., and the other in Indianapolis.

Improved Aluminum Ingots Produced with Electronics

Cleaner and more precise aluminum ingots are being produced at a faster rate through use of an electronically controlled conveyor at the Colonial Metals Co., Columbia, Pa.

In operation, the tapped molten metal runs through a launder into a pouring ladle mounted over the conveyor. The feeding of the positioned molds is electronically timed in accordance with conveyor speed and ingot size. The ingots are dropped from the mold by an electronically controlled air motor.

Through the infinite variations in pouring rate and speed, alloys may be poured under controlled metallurgical conditions.

The unit has a control panel for the adjustment of conveyor speed and automatic pouring. Adjustment through the master control allows the production of ingots of predetermined weight and size. Automatic pouring eliminates excessive agitation of metal and gives a clean, solid ingot free from dross and inclusions.

Selecting A Sand Mixture For Use In Shell Molding

■ Production of shell molded castings begins with the preparation of a suitable resin-sand mixture, and there are a number of alternative choices in mixtures available to the foundryman. These alternatives were described as part of a paper on *"Application of Foundry Resins"* presented at the California Regional Foundry Conference by J. L. Stark, Shadyside Laboratory, Barret Div., Allied Chemical & Dye Corp., Edgewater, N.J.

Dry-blending

Sand and resin may simply be dry-blended or the sand grains may actually be coated. Dry-blended mixtures constitute the bulk of the shell mold mixtures in use. The limitation of the dry-blended mix is that it cannot be used when blowing shell cores or molds.

Principal advantage of dry-blended mixtures is that the mixing can be done in almost any mixer: commercial bread dough mixers, concrete mixers, blenders, and pug mills may be used if a muller is not available.

The use of coated sand is dictated whenever blowing techniques are employed to produce shell molds and cores. In addition, there is growing interest in coated sands designed for dump-box application.

Coating Sand

Sand may be coated with resin by either a hot process or a cold process. Cold-coated sand is prepared by depositing the resin binder on the sand grains and subsequently removing the solvent. Hot-coated sand is produced by melting the base resin, coating the sand at high temperature, and adding the necessary chemicals during a short cooling cycle.

Cold-coated sand is the easiest to control. It does not appear important whether a resin solution is used or whether a powdered resin is mixed with the sand and a solvent added. Cold-coated sands for shell cores are well developed and do not offer much difficulty. However, the same degree of success has not yet been attained with cold-coated sand for dump-box application.

Hot-coated sand is not used as often, primarily because of the higher initial cost for capital equipment and the increased difficulty of controlling a chemical reaction in the muller. Hot-coated sands normally exhibit somewhat better flowability than cold-coated sands. This may be due to a small amount of residual solvent remaining in cold-coated sand.

Sand Selection

The choice of the sand to be coated is as important as the selection of the coating process. Almost any comments regarding sand apply equally to coated-sand and dry-blend mixtures. Selection of a sand for coating is a more critical problem than the selection of a sand for a dry-blend. With either process, the sand used has a greater effect on the success of shell molding than any other variable.

A wide distribution over at least three and preferably four screens is desirable. Only washed and dried sands are acceptable. Whenever possible, the material finer than 270 mesh and the pan material should be less than 15 per cent. Certain bank sands, containing less than 1 per cent clay, do possess an inherent resistance to cracking. It should be noted that the tensile strength of a given resin-sand mix has not been correlated with the ability of the shell to hold metal.

Recently, blending of sands has been successfully investigated with success and a 50-50 blend of silica and bank sands appears promising. The general trend in shell molding is to coarser and coarser sand, with sand of 50-60 AFS Fineness Number now in common use.

Foremen Hold Key to Industrial Productivity

The foreman, as a supervisor skilled in human relations, holds the key which will unlock greater productivity on the part of industrial workers according to a recently published booklet, *"Improving Human Relations."*

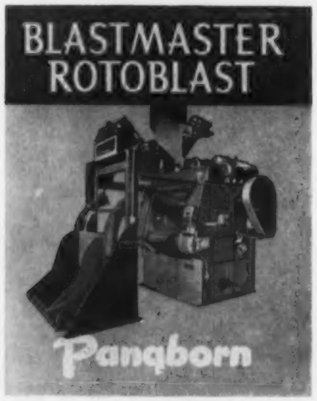
The booklet, published by the National Association of Manufacturers, presents a program designed to help management develop better supervisor-employee relations in the plant. Pointing out that the success of a company "rests heavily on how well the management group performs in achieving person-to-person understanding," the booklet emphasizes that the supervisor, as a member of management, must listen to employees and understand their needs and wants. Thus, supervisors can identify friction spots that can be corrected.

Sound personnel policies, enlightened leadership and effective day-to-day communication between all levels of management, according to the publication, are the ingredients of good human relations in the plant.

The booklet states that the company must rely on communication to secure cooperation and to convey an understanding of its policies and plans.

for the asking

Blast cleaning techniques for automation is explained in 20 pp bulletin containing layout aids, specifications and dimensions on barrels from 1½ to 27 cubic feet. Two-page chart



illustrates types of equipment easily adapted to high-speed cleaning applications. *Pangborn Corp.*
CIRCLE NO. 61, PAGE 7-8

Front loading tractor-shovel bulletin, 4 pp, describes bucket-loading action and bucket roll-back incorporated in improved digging action for handling foundry raw materials. *Frank G. Hough Co.*
CIRCLE NO. 62, PAGE 7-8

Foundry product bulletin, 6 pp, covers performance characteristics, and applications of core binders for conventional oil-sand cores, air-setting cores, CO_2 gassed cores, and resin bonded cores. *Archer-Daniels-Midland Co.*
CIRCLE NO. 63, PAGE 7-8

Magnets, cast and sintered, are described in 12 p catalog. Includes data on magnetic and mechanical properties, approximate tolerances and, magnet assemblies. *General Electric Co.*
CIRCLE NO. 64, PAGE 7-8

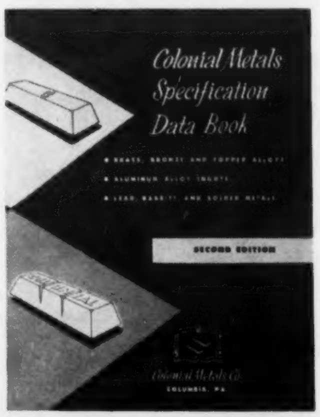
Asbestos-cement core plates and slip jackets are featured in 4 p bulletin. Composition said to resist warpage, are easily cleaned and lightweight. *Johns-Manville.*
CIRCLE NO. 65, PAGE 7-8

Sand preparation machinery bulletin, 24 pp, describes line designed for use in smallest to largest foundries. Includes specifications and photos of equipment in use. *Beardsley & Piper Div., Pettibone Mulliken.*
CIRCLE NO. 66, PAGE 7-8

Power brushes for removing burrs and scale on castings and for cleaning and finishing are featured in 4 p bulletin. Brush specifications and characteristics are listed. *Osborn Mfg. Co.*
CIRCLE NO. 67, PAGE 7-8

Metal removing brochure gives engineering assistance in automating and mechanizing abrasive and abrasive belt machinery. *Carborundum Co.*
CIRCLE NO. 68, PAGE 7-8

Non-ferrous specifications data book covers brass and bronze, aluminum alloys and other metals. Chemical and physical properties are shown for



typical alloys, Also contains formulae for calculating weights of castings. *Colonial Metals Co.*
CIRCLE NO. 69, PAGE 7-8

Temperature measuring instrument catalog, 8 pp, covers optical pyromet-

ers, micro-optical pyrometers, radiation pyrometers, immersion pyrometers and indicating pyrometers. *Pyrometer Instrument Co.*
CIRCLE NO. 70, PAGE 7-8

Aluminum alloys not requiring heat treatment are discussed in 8 pp bulletin giving compositions, physical and mechanical properties. Processing characteristics also covered. *Apex Smelting Co.*
CIRCLE NO. 71, PAGE 7-8

Shell molding sand brochure, 4 pp, covers four grades of shell molding sand, said to contain minimum of clay, alkali, metallic oxides and organic materials. *Pennsylvania Glass Sand Corp.*
CIRCLE NO. 72, PAGE 7-8

Foundry modernization bulletin, 4 pp, discusses recuperative, hot blast, sealed-top cupola; also charging, melting and pouring equipment. *Modern Equipment Co.*
CIRCLE NO. 73, PAGE 7-8

Motor-generator bulletin, 8 pp, covers line which features water-cooled heat exchanger and vertical construction. *Tocco Div., Ohio Crankshaft Co.*
CIRCLE NO. 74, PAGE 7-8

Chill catalog, 18 pp, covers internal and external chills, chilling plates, radius chills, nails, rods, and special shapes. *Canton Chaplet & Chill Div., W. L. Jenkins Co.*
CIRCLE NO. 75, PAGE 7-8

Nickel-chromium white cast iron engineering properties and applications outlined in 62 pp catalog. Includes

chemical analysis and uses in various industries. *International Nickel Co., Inc.*
CIRCLE NO. 76, PAGE 7-8

Zinc base alloy brochure, 34 pp, covers alloys designed for die casting. Included are chemical composition

and sections on alloy temperature, gating and venting of dies, metal injection pressure, surface finish, die finish and operating hints. *Henning Bros. & Smith, Inc.*

CIRCLE NO. 77, PAGE 7-8

CO_2 process equipment including core shooters, gassing apparatus and sand mixer are describer in 4 p bulletin. Gasser said to harden cores in 3 sec. *Carver Foundry Products.*

CIRCLE NO. 78, PAGE 7-8

Molding sand process involving two products designed to give control over the clay-water system is covered in 8 p catalog. Case histories cited. *Eastern Clay Products Dept., International Minerals & Chemical Corp.*

CIRCLE NO. 79, PAGE 7-8

Flux for cupola iron is in brick form to eliminate measuring or weighing. Data sheet describes composition and action in removing non-metallic impurities. *Superflux Mfg. Co.*

CIRCLE NO. 80, PAGE 7-8

High frequency induction heating bulletin, 20 pp, covers the historical development of the process and current applications. *Ajax Electrothermic Corp.*

CIRCLE NO. 81, PAGE 7-8

Non-destructive testing brochure, 14 pp, outlines methods and equipment for inspecting magnetic and non-magnetic materials; also non-conductive, porous and non-porous materials. *Magnaflux Corp.*

CIRCLE NO. 82, PAGE 7-8

Dust collector booklet, 4 pp, describes control in coke handling operations. Discusses system for conveying, screening, and weighing of coke for charging foundry cupolas. *Wheelabrator Corp.*

CIRCLE NO. 83, PAGE 7-8

Epoxy resin foundry applications described in 4 p bulletin. Used in making patterns, core boxes and molds; also for duplicating and repairing castings. *Devcon Corp.*

CIRCLE NO. 84, PAGE 7-8

Graphite base refractories catalog, 24 pp, covers products, installation of refractories and advantages of graphites. *Mexico Refractories Co.*

CIRCLE NO. 85, PAGE 7-8

Spectrochemical analysis brochure, 28 pp, describes basic fundamentals and includes bibliography for reference material. Outlines methods, instruments and accessories and examples of analytical problems, suggested

laboratory floor plans and data on special purpose instruments. *Jarrell-Ash Co.*
CIRCLE NO. 86, PAGE 7-8

Snagging grinder bulletin, 6 pp, covers line of high-speed machines including single and double wheel types. *Standard Electrical Tool Co.*
CIRCLE NO. 87, PAGE 7-8

Dust control bulletin, 16 pp, describes importance of dust control in relation to reduced maintenance costs and commercial utilization of by-products. Outlines standards of control and efficiency and lists primary component parts of an engineered dust control system. *Pangborn Corp.*
CIRCLE NO. 88, PAGE 7-8

Patternmakers lathe for wood or metal, described in 4 p bulletin. Made in 4 sizes. Bed supplied in any length; power feeding optional. *Oliver Machinery Co.*
CIRCLE NO. 89, PAGE 7-8

Fork lift truck, 4000 lb. capacity, described in 4 p. bulletin listing lift speeds, drawbar pull, and capacities at various loads centers and overall measurements. *Clark Equipment Co.*
CIRCLE NO. 90, PAGE 7-8

Phenolics products catalog, 12 pp, includes phenolic laminating varnishes and industrial and foundry resins. Contains technical data, special properties and product features. *Chemical & Metallurgical Div., General Electric Co.*
CIRCLE NO. 91, PAGE 7-8

Cupola operation service-type bulletin, 8 pp, discusses factors of cupola operation that affect combustion and melting conditions. Emphasis placed on importance of coke quality, material size, stock distribution and hang-ups. *Whiting Corp.*
CIRCLE NO. 92, PAGE 7-8

Pulsating panel bulletin, 4 pp, outlines use as auxiliary feeder in bulk storage bins. Applicable to all types of hoppers. *Gerator May Corp.*
CIRCLE NO. 93, PAGE 7-8

Refractory catalog, 24 pp, covers standard and special types of brick and linings for electric furnaces. Also contains thermal conductivity chart of common refractories. *Mullite Refractories Co.*
CIRCLE NO. 94, PAGE 7-8

Shell molding resins are covered in 32 p bulletin. Includes design and production considerations, available types of molding machines, gating

CIRCLE NO. 169, PAGE 7-8

techniques and precautions, pattern design, special metals handling and sand reclamation. *Barrett Div., Allied Chemical & Dye Corp.*
CIRCLE NO. 95, PAGE 7-8

Fork lift truck bulletin details use of equipment at Wisconsin foundry. Includes photos of trucks in use and description of equipment. *Buda Div., Allis-Chalmers Mfg. Co.*
CIRCLE NO. 96, PAGE 7-8

Chemically-bonded brick bulletin, 4 pp, outlines foundry uses and properties. Available in standard fire brick and cupola sizes. *Illinois Clay Products Co.*
CIRCLE NO. 97, PAGE 7-8

Refractory manual, 48 pp, describes step-by-step directions for installing brick and ramming mixes in electric furnaces; contains section on furnace lining repairs and suggests methods for rebuilding and heating up furnaces. Fold-out chart aids in estimating brick requirements. *Kaiser Aluminum & Chemical Sales, Inc.*
CIRCLE NO. 98, PAGE 7-8

Zinc industry review for 1956, 15 pp, summarizes production and consumption. Also discusses growth of zinc for die casting. *American Zinc Institute, Inc.*
CIRCLE NO. 99, PAGE 7-8

Speed reducing bulletin, 24 pp, covers lines of concentric shaft and right angle speed reducers for applications up to 140 hp. Horsepower and torque ratings are given as well as dimensions, overhung load and thrust capacities, and application pictures. *Falk Corp.*
CIRCLE NO. 100, PAGE 7-8

Drill press bulletin, 12 pp, describes line. Specifications given for floor and bench, single and multiple spindle models in several basic sizes. *Delta Power Tool Div., Rockwell Mfg. Co.*
CIRCLE NO. 101, PAGE 7-8

Gravity and power belt conveyor bulletin, 4 pp, describes basic units, portable lines, and controlled flow systems. Includes photos of equipment in use. *Rapids-Standard Co., Inc.*
CIRCLE NO. 102, PAGE 7-8

Temperature conversion chart, 3½x8½ in., shows Fahrenheit and Centigrade temperature equivalents. May be carried in pocket or wallet. *Moeller Instrument Co.*
CIRCLE NO. 103, PAGE 7-8

Materials handling equipment brochure, 4 pp, lists various all-steel ramps for railroad car, truck, and

trailer truck loading. Also covers pallets with self-supporting standards which collapse for compact storage. *Elizabeth Iron Works, Inc.*
CIRCLE NO. 104, PAGE 7-8

Freight car handler bulletin, 4 pp, describes freight handling efficiency obtained by unit equipped with steel rail wheels and rubber-tired wheels. *Whiting Corp.*
CIRCLE NO. 105, PAGE 7-8

Smoke density estimating instrument using optical instrument giving direct comparison between smoke and reference shades with same background light described in technical bulletin. *Mine Safety Appliances Co.*
CIRCLE NO. 106, PAGE 7-8

Foundry alloy products book discusses ductile iron additives, ferro-alloys, molybdenum alloys, monel and nickel. Data section contains conversion table and glossary. *Whitehead Metal Products Co., Inc.*
CIRCLE NO. 107, PAGE 7-8

Fork lift truck, 7000 lb. capacity, gas or diesel operated, featuring direct-drive hydraulic pump, is covered in 2 p bulletin. *Towmotor Corp.*
CIRCLE NO. 108, PAGE 7-8

Floor truck and storage rack catalog, 20 pp, features 4-wheel and 2-wheel trucks, dollies, trailers, dragline trucks and barrel and drum trucks. Storage racks of three different types of pallet racks are also covered. *Lewis-Shepard Products Inc.*
CIRCLE NO. 109, PAGE 7-8

Battery catalog, 4 pp, covers use with rider-type electric industrial trucks. Specifications include battery ratings and capacities, details of construction, dimensions and weights. *C & D Batteries, Inc.*
CIRCLE NO. 110, PAGE 7-8

Sound control bulletin, 4 pp, discusses use of panels for reducing industrial noises. Made of steel to cut sound transmission and fibre glass to absorb noise. *Rysdon Products Co.*
CIRCLE NO. 111, PAGE 7-8

Materials handling catalog, 28 pp, illustrates trailers, jacks and skids, 27 different models of 2-wheel and 4-wheel platform trucks plus variety of casters and special duty equipment. *Nutting Truck & Caster Co.*
CIRCLE NO. 112, PAGE 7-8

Grinding line bulletin, 8 pp, includes surface grinders, floor and bench tool grinders, workholding accessories and

metal dust collector. *Walker-Turner Div., Rockwell Mfg. Co.*
CIRCLE NO. 113, PAGE 7-8

Double-dome skylights of fibre glass-reinforced polyester plastic are highlighted in bulletin 8A, 4 pp. Will support 200 lb per sq ft. *Consolidated General Products, Inc.*
CIRCLE NO. 114, PAGE 7-8

High-strength corrosion resistant alloy developed at Ohio State University is discussed in 4 pp bulletin including physical characteristics. *Alloy Casting Institute.*
CIRCLE NO. 115, PAGE 7-8

Hook scale bulletin M-25 4 pp explains hydraulic scale which is accurate within ¼ of 1 per cent of capacity at any point. Weighs to 20,000 lb. *Martin-Decker Corp.*
CIRCLE NO. 116, PAGE 7-8

Heat treating furnace for utility use from 250 to 1750 F is described in 4 pp bulletin with explanation made of "radivection" principles. *A. F. Holden Co.*
CIRCLE NO. 117, PAGE 7-8

Hook Line Conveyor Speeds Production in California

Increased production, better utilization of floor space and greater control of individual parts has been achieved by the Gaines Co. foundry, Rivera, Calif., through a hook line conveyor system.

The production line served by the system covers 5000 sq ft of the 30,000 sq ft plant which makes 20,000 lb. of aluminum and magnesium castings per eight-hour shift. Castings up to 300 lb. can be handled on the permanent mold line but castings average considerably under this since most of the production goes into aircraft production.

The conveyor is 230 ft long and has 250 hooks that travel at 15 or 30 ft per min as desired. The system has reduced the normal production flow from 60 to 48 hr. Thirty-two different jobs can be run on the assembly line simultaneously.

After the castings have been removed from the mold they are hooked onto the conveyor line and the cores are knocked out. They next move to an inspection station. The inspection rate has been increased considerably since all pieces are routed past one station.

Use of the system enables foremen to know the exact production status of each job on the line. Parts are no longer stacked on the floor in the immediate mold area.

Study Needs Before Using New Methods, Says Bishop

■ The best core is the cheapest core that produces a cavity effectively; an alert foundryman will analyze his requirements and use that process where it will most economically lend itself to his use, stated Warner B. Bishop, vice-president, Archer-Daniels-Midland Co., in discussing *"Which Core Process?"* at the AFS Southeastern Regional Foundry Conference, held Feb. 21-22 at Birmingham, Ala.

Since World War II we have encountered many new processes for producing castings, stated Bishop. "In the core room there are at least three major new ones. These are hollow cores, gas setting cores, and air setting cores. It behooves the intelligent foundryman to be familiar with them and then, based upon the applications and idiosyncrasies of his particular work in his particular foundry determine which fits best where.

"Each process has advantages and disadvantages and each generally lends itself best to a certain segment of work.

"Generally speaking, the conventional oil-sand or resin-sand-cereal mixes baked in a gas or oil fired oven are the least expensive and will best lend themselves to long runs where economy is the keynote. As such they will continue to be the basic process. Hollow cores, with the use of phenol formaldehyde and hot core boxes, probably best lend themselves to long runs which can amortize the high cost of equipment, and those jobs where maximum tolerance and finish are required and where the omission of driers during baking can help amortize the cost of expensive materials and equipment.

"The gas setting process, which consists of using a sodium silicate base binder and CO_2 gas, has the advantage of speed of cure of cores but presents a paradox in that its gassed strengths are low and if it is baked to enhance strength has a tendency to resist collapse during cleaning. It finds its best use in short runs or in a shop which has a variety of jobs and does not particularly want to invest in driers and can, by the use of the gas setting process, avoid the use of driers and use inexpensive core boxes.

"The air setting process consists of using a binder, oxidizing agents and catalysts, and a dry sand. Its use is primarily directed at heavy floor work where omission of rods, wires, and arbors can be of value and where skilled labor can be dispensed with in production of such cores. These cores, after fabrication, air set to a high degree of strength and bake quickly to obtain optimum strength."

Grinding Wheels Shipped in Cardboard Tubes

Safer and more convenient stocks of small grinding wheels may now be maintained in foundries as a result of shipment in cardboard tubes similar to conventional mailing tubes.

Packaging experts report that the cardboard containers make for simple removal of one wheel at a time and afford protection against damage in storage. Each cardboard tube is clipped over a stack of ten wheels. On large orders, sealed tubes are then stacked on end in shipping containers. Small wheels were formerly shipped on strings in multiples of ten.

The use of mailing tubes for shipment is said to permit the easy removal of one wheel at a time. The tubes also protect wheels from damage in storage. Small orders packed in tubes can be shipped by mail and the handling and shipping of all orders is reported to be facilitated.

Electro Refractories & Abrasives Corp. is now shipping wheels as large as three inches in tubes.

the SHAPE of things

safety, hygiene, air pollution

by HERBERT J. WEBER

Epoxy Resins and Dermatitis

The increasing acceptance of epoxy resins for new applications has emphasized their usefulness, especially in the patternmaking trade. This growing popularity is due to the use of amines as room-temperature hardeners or curing agents for epoxy resins. Common solvents are acetone and methyl ethyl ketone.

The polyamines used with epoxy resins as hardeners, while of a low order of toxicity if swallowed, are among the most potent primary skin irritants. This reaction is further complicated by a high incidence of skin sensitization. Once sensitization occurs, further exposure even to small amounts of resin will bring on another episode of dermatitis. Increasing reports are being received of episodes of dermatitis among employees caused by solvent or dust contact with the skin.

An employee who works all day in a cloud of resin dust from sanding operations or who frequently washes his hands in acetone in order to remove resins, may add hidden costs to production. In one shop, a time study of a sanding operation produced a figure of 37 pieces/hr, but the job was so dusty that only 28 pieces/hr were produced, some of which did not pass inspection. When the employee developed dermatitis, a new man taking his place produced only 23 pieces/hr. Because of the dust, a third man devoted full time to housekeeping and cleaning dust from parts produced. When the first employee returned to work, and his medical bills were paid, the second man developed dermatitis from the same job. These two cases resulted in increased compensation insurance cost.

After control measures were adopted, 41 pieces were sanded per hour; there was no need for the clean-up man, and scrap was reduced.

Thus, aside from the moral aspects, prevention of dermatitis resulting from epoxy resins saves money. The control of exposure is twofold: control of the environment and control of employee habits. The environment is easier to correct, but most industrial dermatitis can be avoided by proper handling of the resins and solvents. It is mainly a matter of avoiding unnecessary contact with the skin and seeing to it that employees practice thorough personal hygiene. Adequate facilities for washing, showering and changing work garments should be provided.

The frequent washing of the hands in acetone to remove dried resins has led to dermatitis, sometimes followed by infection because acetone de-fats and dries the skin.

The wearing of rubber or latex gloves over a pair of "throw-away" cotton gloves has been found to give effective protection. Hand creams have been of some benefit, especially when used as an adjunct to other personal protective clothing.

A simple safety rule would be: "Avoid contact as much as possible with the resin and solvent by any feasible means, and observe strict personal cleanliness."

A new low-irritant hardener is now commercially available. Tests show that harmful effects are greatly reduced or eliminated, yet physical properties of the resin hardened by it are comparable to those obtained with polyamines.

Conventional polyamine hardeners and the new low irritant hardener were tested on fifty human subjects. Patch tests are read as 0, 1 +, 2 +, 3 + and 4 + reactions; the higher the test number the more severe the reaction. Generally 3 + and 4 + reactions on final application are regarded as indicative of sensitization.

With the conventional hardener, 35 of the 50 subjects showed either 3 + or 4 + reactions. On final application (two weeks after, the last series patch) 21 showed 3 + reactions and one a 4 +.

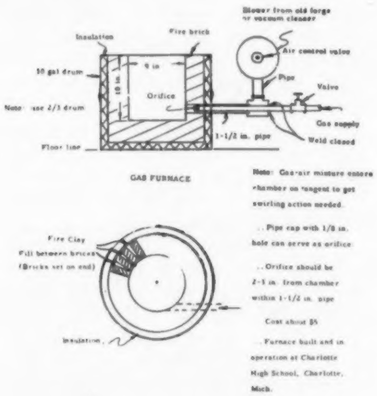
With the low-irritant hardener, 2 of the 50 subjects showed 3 + reactions and on final application 4 showed 2 + reactions and there were no 3 + reactions.

The results of the test also showed that even the low irritant hardener affects some persons. Of course, one can attribute this to individual susceptibility. It has been known for a long time that some persons are sensitive to the most harmless things.

Ingenuity, Outside Help Give School $50 Lab

A high school foundry for $50? It doesn't seem possible but Charlotte High School, Charlotte, Mich. has such a program. Other high schools can have similar programs with a modest investment.

Considerable outside help is usually available from the American Foundrymen's Society, local foundries or universities. In the case of Charlotte High, aid was obtained from the AFS Central Michigan Chapter, Michigan State University and foundries in the area.



Furnace used at Charlotte.

Much of the equipment can be made in the high school shop. This includes riddles, rammers, sprue pins, gate cutters, strike-off bars, flasks, bottom boards, foundry benches, storage bins and the furnace. Equipment to be purchased includes slicks, trowels, shovels, crucibles, broom, sprinkling can, lifter and water bulb.

The location of the foundry is often dictated by the availability of gas supply or location of exhaust equipment. A separate room with a minimum of 144 sq ft makes the best location. However, an isolated corner is also satisfactory. The scattering of fine dry sand will present a cleaning problem which can be kept to a minimum by using a sweeping compound.

Classes should be confined to 10 students. This means two or three demonstrations for each class. Two class hours are usually required to introduce new equipment before demonstration or actual work begins. Theoretical material is best introduced with motion pictures or slides.

At Charlotte High, the foundry program begins in the 10th grade machine shop course and deals only with the fundamentals of making and pouring a simple mold. The course becomes more advanced in the 11th and 12th grades.

Birthplace of Iron Industry Open for Tourists

The Saugus Ironworks Restoration, the 300-year-old "birthplace" of America's iron and steel industry, opened for the 1957 tourist season on April 16.

In 1956 almost 22,000 persons visited this attraction on U.S. Route 1, 10 miles north of Boston. Built more than 130 years before the American Revolution, the original Saugus Ironworks was the industrial wonder of the day. It operated from about 1646 to 1670 producing much of the iron for a fast growing country.

Reproduced in authentic detail in the Restoration are the blast furnace, forge, rolling and slitting mill, and the ironworks' wharf and warehouse.

Much of the equipment is the restored plant is now operative. The restoration includes the home of the ironmaster and a museum which houses relics and tools from the original plant which were unearthed by archeologists during the rebuilding. The Saugus Ironworks was rebuilt in 1954 by the American iron and steel industry because of the historical and educational significance of the pioneer plant.

dietrich's corner

by h. f. dietrich

Obsolescence is a sign of progress in a changing world.

One day long ago, on the banks of the Euphrates, an ancient king looked over his gang of free loading "Yes men," and decided to cut the food bill.

"Mike," he said to one with an exceptionally ample paunch, "You've had your feet in the food trough for quite a spell without coming up with a wisecrack to pay for it. Here's the deal. I want you to come up with a proposition that will fit all things, under all conditions, at all times. Take your time. I'll see you tomorrow morning—before breakfast."

Now, Mike's mother didn't raise any dumb house apes, but this one had Mike stopped. This truth-or-consequence game was for keeps.

By sunrise, Mike realized that it had been a mistake to pose as a Wiseman. The mortality rate was high on that job. He kept his appointment with the king with a feeling that his meal ticket had been punched out.

"Sire," he said sadly while patting himself on his king-sized repository for roast lamb, "This too shall pass away."

"That's it!!" yelled the king. " 'This too shall pass away!' It fits all things, under all conditions, at all times."

This story reminds me of the things that have passed away in the foundry. Bellows, corner slicks, and four-part herringbone gear patterns have gone the way of the twelve hour day. If you can remember straw vent ropes that used to be embedded in cores, perhaps you have lived too long. *This is indeed a changing world in which men scheme and build to give future generations magnificent ruins.*

In 1923, in Racine, Wis., mule drawn ladle cars were still being used. Crane service was lousy, and mules were used to pull the bull ladle from one floor to another along a track in the gangway. Horses were not psychologically suited to the job. If a mule got a hot spark under his tail, he stubbornly clapped his tail down and refused to move. A horse, on the other hand, would throw his tail high and move toward an outside wall. If there was a door he would use it. Otherwise, he would make his own door.

What happened to the long woolen underwear that was standard safety equipment for molders? And where are the hand floor rammers with brass peen and butt cast onto a pipe? They were used in the days when the salamander heater would start the day by smoking your eyes into tears. After you had a fire started, you were in a position to choose which side you wanted roasted while the other side froze.

To break open a sand heap meant just that. You would split the heap down the middle with a shovel. Then throw a two inch layer of frozen sand off to get at the unfrozen sand under it. Making a drawback parting with ice-cold sand, fingers numb and blue with the cold, certainly left something to be desired in the way of comfortable living.

An interesting ritual performed by all good molders was called rushing-the-can. In every foundry, someone owned a can of prescribed characteristics and dimensions. Not *any* can would do. The proper can had thin side walls, a cover with flange fitted inside of the body, and a capacity just slightly under that of a milk cooling container.

The time of the ritual was an important element. It had to be late in the afternoon—just after the gangwayman had hauled his last load of boards to the molders. By rotational selection, someone would donate the dime. The gangwayman would go over the back fence and across the street to where a saloon keeper ruled his domain with a bungstarter.

On a hot August afternoon, after nine hours of floor molding with a hand rammer, there is *nothing* that tastes quite like draught beer drawn through icy copper coils into a thin-walled bucket.

After pouring off, you could stop at the corner saloon for free lunch of pickled herring, pumpernickel, pretzels, salami, salt smelt, and limburger. All this with a five cent glass of beer. If you smelled like anything human after that, it was purely accidental.

Those good old days too have passed away—thank heavens.

Chilean Foundrymen Complete Study of U.S. Metal Castings Industry

■ A productivity team of iron and steel foundrymen from Chile has just completed a six-week study of foundries in the U.S. The study, conducted under the direction of the International Cooperation Administration, included tours of foundries in Pittsburgh; Cleveland; Grafton, Ohio; Chicago; Detroit; and Philadelphia.

In visiting foundries, the Chileans placed emphasis on the study of management organization, administrative and service departmental functions, production, and plant level research and development. Other points that the touring foundrymen studied were concepts of productivity, living standards of workers, and organizations serving the industry.

Included in the study of organizations serving the foundry industry, was a day spent at the national headquarters of the American Foundrymen's Society, Des Plaines, Ill. Here, the visitors heard about the purposes and activities of the society and viewed two motion pictures illustrating research into horizontal and vertical gating for light metals.

Chilean foundries are generally small to medium in size and produce a variety of cast products. Many of the Chilean plants produce both ferrous and non-ferrous castings. The foundries represented by the productivity team produce castings for agricultural, marine, railroad, mining, and other industrial machinery; centrifugally cast pipe; pipe fittings; sinks, bathtubs, and other sanitary equipment; kerosene and wood burning stoves and heaters.

Foundries on the group's itinerary were:

Cleveland – Fulton Foundry and Machine Co., Inc.; West Steel Castings Co.; Eberhardt Mfg. Co.

Grafton, Ohio – W. O. Larson Foundry Co.; Grafton Foundry Co.

Chicago–Pettibone-Mulliken Corp.; Capital Brass & Aluminum Foundry Co.; Arrow Pattern and Foundry Co.

North Chicago, Ill.–Chicago Hardware Foundry Co.

Detroit–Lincoln Brass Works, Inc.

Burlington, N.J.–U. S. Pipe and Foundry Co.

Philadelphia–H. D. Enderlein Co.

Chilean visitors check equipment used in AFS research gating studies. Visitors and hosts, left to right, Hernan Cabera, International Cooperation Administration, Washington, D. C.; Eugenio Diaz, Fundicion de Acero SINZ, Av. Pdte.; Guillermo Rosenberg, Fundicion Nuble; S. C. Massari, AFS technical director; Wm. W. Maloney, AFS general manager; Francisco Fuente's Smelting; Pose Leal, Industries de Estano y Aceros S. A.; Miguel Rabb Jeanneret, Raab, Rochette y Cia. Ltda.; Barbara Huntley, translator; Muguel Allamand, Sociedad General Mechanica y Metalurgia; Jaime Claramunt; Fundicion y Fabrica de Friferia Santaria.

local foundry news

Texas Foundry Gives Oscar Awards to Five for Outstanding Services

Malleable statues presented annually to management staff

Hollywood invaded East Texas in December when "Oscars" were presented to five members of the Texas Foundries, Inc. management staff.

These Oscars, made of malleable iron, are awarded yearly. Engraved on the base is "For Meritorious Service During 1956." During the last six years, 39 awards have been made.

The award ceremony has all the pagentry and excitement of the Hollywood awards. The presentation is made each year at the annual Christmas party. No one knows in advance who will receive the Oscars.

The Oscar calls for recognition of meritorious service by supervisors, foremen, salesmen and administrative people whose efforts effect the material and financial progress of the company. The company department heads cannot receive an Oscar but they recommend candidates to decide who will comprise a three-man top management awards committee.

Texas Foundries' Oscar is held by John S. Lawrence, melting foreman. Other winners appearing left to right are: Donald R. Patterson, cost estimator; Leonard B. Jones, chief inspector; Richard R. McWhirter, employee counselor; and Stanford O. Smith, chief metallurgist, steel division.

Plaster Molding Practice Explained at Connecticut

Plaster molding and its use in foundries was explained to members of the Connecticut Non-Ferrous Foundrymen's Association at its February meeting. Julius Ferrari, Victor's Foundry, Guilford, Conn., was the featured speaker. Ferrari said that patterns must be precise and preferably made of bronze. Wood patterns, he stated tend to swell and deform due to the moisture content of the plaster. The speaker advocated judicious use of vents, pop-offs, risers, and whistlers to relieve pressure build-up in the mold cavity. Ferrari pointed out that molds must be poured immediately after curing as plaster is a hygroscopic material.

Quad City Chapter's first meeting of its six-week educational program attracted 225 persons in February. Attending were casting designers and buyers as well as foundrymen and high school students. W. O. McFatridge, International Harvester Co., Chicago, spoke on *"Fundamentals of Foundry Practice."* The speaker emphasized requirements needed to produce quality castings. The sessions ended April 4.

CO_2 Talk at Chesapeake

Chesapeake Chapter members at the March meeting heard Bernard N. Ames, Columbian Bronze Corp., discuss CO_2 molding. Ames described the molding of large and small ship propellers made by the process. Slides were used to illustrate how to inject gas to the bottom of patterns. The speaker said that the CO_2 facing need be only two or three in. deep with molding sand used for the backing.

CO_2 cores and modifications were discussed by Joseph Krishon, Mueller Brass de Mexico, S.A., at the March meeting of the **Mexico City Chapter.** Shown in photo left to right are: Delbert Luper, past president of the chapter; Vicente Nacher, Chapter Vice-President; Esteban Fuchs, Chapter President; Speaker Krishon, and Luis Delgado Vega, Chapter Secretary-Treasurer.

Western Michigan Holds Panel on Preventive Maintenance

A panel discussion on preventative maintenance was held at the February meeting of the Western Michigan Chapter. The talks centered around maintenance of belting, compressors and bearings. Panelists were H. R. Wickenden, Goodyear Tire & Rubber Co.; Jim Brown of Keller Tool Co.; and E. J. Moore, Detroit Ball Bearing Co.

Lehigh Valley Discusses Defects Caused by Sand

Casting defects caused by sand were outlined at a recent meeting of the Lehigh Valley Foundrymen's Association by G. F. Watson, American Brake Shoe Co., Mahwah, N.J. Discussed were burnt-on sand, veining and scabbing for various bronze alloys, steel and gray irons. The speaker also gave suggestions on how to cure these defects. More than 100 persons attended the meeting at Lafayette College, Easton, Pa.

Shrinkage Control Discussed at Timberline's March Meeting

Shrinkage control was outlined by Michael Bock II, Exomet Inc., at the March meeting of the Timberline Chapter held in the Oxford Hotel Denver, Colo. Slides and demonstrations were used to illustrate the discussion. Darrell C. Durant, chapter president presided; D. C. Card, chapter vice-president was the technical chairman.

Texas Chapter members at the March meeting in Fort Worth saw a movie featuring chaplets and chills. Shown in photo at left is W. F. Geiger, Bethlehem Supply Co. and on right is C. T. Wilson, Oil City Iron Works, both of Corsicana, Texas.

Olson Speaks at Utah

Utah Chapter members at the March meeting in Provo, Utah, heard R. L. Olson, Dike-O-Seal, Inc., Chicago, discuss *"Pattern Construction and Rigging—Improved Techniques in Coreblowing and Core Quality."*

San Antonio Covers Shifts

Causes of shifts in loose pattern molding were covered in an open discussion at the March meeting of the San Antonio Section of the Texas Chapter. The session was attended by 29 members and guests.

Increased emphasis on foundry studies was indicated for Massachusetts Institute of Technology, Cambridge, Mass., by C. C. Reynolds, assistant professor of metallurgy, in discussing developments in the foundry industry at a recent meeting of the **Philadelphia Chapter.** M.I.T. at present is working on projects involving ductile iron; high-strength alloys; melting; sands and binders; gas injection and shell molding. Prof. Reynolds appears on left with Chapter Chairman W. S. Giele. At the March meeting, Dr. William H. Ruten, Polytechnic Institute of Brooklyn, N. Y., discussed *"The Foundry is a good Place to Work."* The speaker said that foundries represent a basic, creative and progressive industry, rich in historical background.

Metropolitan Chapter Meets with Brooklyn Poly Students

Students of the Brooklyn Polytechnic Institute Student Chapter of the American Foundrymen's Society were guests of the Metropolitan Chapter at the February meeting held in Newark, N. J. Prof. Howard F. Taylor, Massachusetts Institute of Technology, spoke on "The Chemistry and Mechanics of Molding Materials." Taylor showed how improvements in flowability could be achieved by small modifications to such physical characteristics of sand as grain size and inter-granular friction.

James H. Smith, Central Foundry Div., GMC, addressed the **Reading Foundrymen's Association** at a recent meeting and emphasized that "Foundry progress will require a continuing supply of talent with new ideas." Smith appears on the right. Others left to right are Association officers: Paul K. Reiniger, president; William I. Cassidy, secretary; and Herman P. Good, technical chairman.

Apprentice contest awards were made at the March meeting of the **Oregon Chapter.** Contests were held in five divisions. Winners were: iron molding, Wayne Miller; steel molding, James Rogers; non-ferrous molding, Jack Spackman; wood patternmaking, L. K. Bruenn; and metal patternmaking, Richard Rudig. Shown in the photo, back row, left to right: Jack Spackman, Pacific Chain & Mfg. Co.; Jim Rogers, Oregon Steel Foundry Co.; E. E. Kinyon, Columbia Steel Castings Co.; Maurice Guinthar, Crawford & Doherty; Wayne Miller, Crawford & Doherty; Alf Nilsen, Western Steel Casting Co.; L. K. Bruenn, Dependable Pattern Works. Front row, left to right, Charles Wanless, Northwest Foundry & Furnace Co.; Robert Kile, Western Foundry Co.; Wesley Meador, Dependable Pattern Works; Richard Rudig, Dependable Pattern Works; Nobert Aicher, Willamette Pattern Works; Charles Waldow, Willamette Pattern Works.

The Industrial Committee for Foundry Educational Foundation recently held its spring meeting at the University of Illinois. Following the meeting a dinner was served to approximately 50 students. Marion J. Allen, American Steel Foundries, talked on *"The Opportunities for Engineers in the Foundry Industry."* Ellis Zickefoose, Griffin Wheel Co., showed a film on the manufacture of steel wheels. Left to right are R. L. McElhiney, Vice-Chairman, Student Chapter; Prof. N. A. Parker, Department of Mechanical Engineering; Dean W. L. Everitt, Dean of College of Engineering; Ellis Zikefoose, Marion J. Allen; and Charles Fausel, Central Foundry Div., GMC, Danville, Ill.

Saginaw Valley Chapter annually sponsors a Students Activity night as a function of its educational committee. This year eight senior students at the General Motors Institute of Technology conducted the program. Kenneth D. McKibben acted as meeting chairman and introduced the seven speakers. Left to right in photo are Kenneth D. McKibben, Carl A. Tobias, Bernard Billings, George Mauch, Lance Johnson, John Lowe, Jerome Reames, Glen Ohl, James Booth, James E. Bowen, and James Walpole. In February the chapter conducted a dinner-dance at the Bancroft Hotel, Saginaw, Mich.

Armstrong Elected President of AFS New England Chapter

New England Chapter officers and directors have been elected. Clyde W. Armstrong, Warren Foundry & Pipe Div., Shahmoon Industries, Inc., Everett, Mass., is president. Other officers are: 1st vice-president, Alexander Beck, Whitman Foundry, Inc., Whitman, Mass.; 2nd vice-president, William N. Ohlson, Draper Corp., Hopedale, Mass.; and secretary-treasurer, Thomas I. Curtin, Jr., Waltham Foundry Co., Waltham, Mass. Directors are: Ahti A. Erkkinen, Fremont Casting Co., Worcester, Mass.; William Hale, Springfield Foundry Co., Indian Orchard, Mass.; Romeo J. Lemoine, Fitchburg Foundry Inc., Fitchburg, Mass.; Warren J. Murdock, Helantha Corp., East Boston, Mass.; Phillip C. Smith, General Electric Co., West Lynn, Mass.; Lewis W. Greenslade, Jr., Brown & Sharpe Mfg. Co., Providence, R. I.; Harry K. Sleicher, Seaboard Foundry, Inc., Providence, R. I.; Herbert H. Klein, Klein-Farris Co., Inc., Boston, Mass.; John H. Orrok, Debevoise-Anderson Co., Inc., Boston, Mass.; Albert M. Nutter, E. L. LeBaron Foundry Co., Brockton, Mass.; and Charles A. Reed, Cambridge, Mass. The membership co-chairmen are Herbert H. Klein and John H. Orrock. Alexander Beck is the program chairman.

Outline Supervisor Problems at Quad City March Meeting

Developing supervisory personnel was explained by C. L. Schwyhart, Caterpillar Tractor Co., at the March meeting of the Quad City Chapter. The speaker stated that securing competent supervisors was essential to successful operations. He said that considerable loss of material and money could be traced to poorly trained personnel.

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Gating and risering principles were explained to members of the **Central Ohio Chapter's** February meeting by Harry H. Kessler, Sorbo-Mat Process Engineers, St. Louis, Mo., who said "Uniformity of metal alloys is dependent upon the quality of raw materials used and the consistency of melting operations."

Metal Core Box Discussion Held at Washington Meeting

Approximately 60 foundrymen and apprentices attended the March meeting of the Washington Chapter held at the Engineers' Club in Seattle, Wash. Principal speaker was R. M. Ronne, Dependable Pattern Works, Portland, Ore. Ronne described the different types of core boxes and pointed out the versatility of metal boxes. He stated that metal gang-boxes with cold rolled steel inserts and plates were used for core blowing. The speaker pointed out that screen vents are preferred over slotted vents, however, the latter are better suited for contour surfaces. Ronne said that in the production of shell cores a 5 second investment will cure in about 15 seconds and an 8 second investment will cure in 25 seconds. Slides were used to show the manufacture of metal core boxes.

March was apprentice contest month for the **St. Louis Chapter.** Competition was held in wood patternmaking, metal patternmaking and gray iron molding. Winners of the first three places in each division received prizes of $15, $10, and $5. Each of the prize winners had his project entered in the national contest. First place winners received plaques from the Central Pattern Co., St. Louis. Winners left to right are: metal patternmaking, Joseph Wilson, Central Pattern Co.; gray iron molding, Charles Simpson, Tower Grove Foundry; and wood patternmaking, Richard Dvorak, Consolidated Pattern Co.

MILWAUKEE CHAPLET PHOTO

More than 550 persons attended the March meeting of the **Wisconsin Chapter.** Featured speaker was Clarence E. Mannion who discussed *"The Management of Freedom."* The speaker stated that authority is being transferred to the federal government which has brought a tremendous increase in the cost of administration and higher taxes.

Mechanization in Foundries Highlight of Texas Session

Foundry mechanization was featured at the March meeting of the Texas Chapter held at Longview, Tex. Principal speaker was Glenn W. Merrefield, Giffels & Vallet, Inc., who discussed various degrees of mechanization for yard handling and storage; charging and melting; metal handling and pouring; sand preparation and delivery; shakeout; casting handling; casting cleaning, inspection and reclaiming; ventilation, smoke and dust suppression.

Northeastern Ohio Sand Clinic

Northeastern Ohio Chapter's educational committee conducted a three-day sand reclamation clinic, March 19-21 at Case Institute of Technology, Cleveland. Victor Rowell, Harry W. Dietert Co., Detroit, was the principal speaker. Warner B. Bishop, Archer-Daniels-Midland Co., Cleveland, discussed *"Newer Processes."* Prof. J. F. Wallace, Case Institute of Technology, served as host and program coordinator. Attendance averaged 125 daily.

Michiana Chapter's February meeting was attended by AFS National Director Gerald Rusk. Flanking Rusk on the left is Edward Zuppmann, chapter vice-chairman. On the right is Chapter Chairman Floyd Crowley, the evening's speaker whose subject was foundry sands.

Water-Cooled Cupola Topic at Central Illinois Meeting

Approximately 120 foundrymen attended the March meeting of the Central Illinois Chapter held at the American Legion Hall, Peoria, Ill. William Dawson, Kelsey-Hayes Co., Detroit, discussed *"Water-Cooled Cupola."* Slides were used to show the development of the cupolas at Ford Motor Co. Dawson said that the required physical and chemical properties of metals can be obtained with savings in maintenance costs and utilization of cheaper basic materials.

MILWAUKEE CHAPLET PHOTO

Pittsburgh Chapter's February meeting was was addressed by Norman A. Birch, American Brake Shoe Co., shown on right, who discussed *"Non-Ferrous Foundry Practice."* On left is Steve Kundrat, evening program chairman.

Western Michigan Hears Scobie

New developments in the foundry industry were discussed at the March meeting of the Western Michigan Chapter by Herbert Scobie, executive secretary, Nonferrous Founders' Society. Scobie told the 100 attending foundrymen that new techniques and processes were keys to progress and that customers must be kept informed of advances made by the foundry industry. Processes discussed by the speaker included CO_2 molds and cores, mica strainer cores, waterless sand, core shooting, combustion control and improved fuels. Scobie also stressed the necessity of redesigning parts to benefit from casting advantages.

Michigan Regional Conference Announces Fall Dates

Committees have been named for the AFS 1957 Michigan Regional Conference to be held Oct. 3-4 at Kellogg Center, Michigan State University, East Lansing, Mich. The Conference is sponsored by the Central Michigan, Detroit, Saginaw Valley, and Western Michigan Chapters and the Student Chapters of Michigan State University and University of Michigan. R. B. Kropf, International Nickel Co., will be conference chairman. J. R. Young, Cadillac Motor Car Div., GMC, will be conference secretary; and W. E. Truckermiller, Albion Malleable Iron Co., will be chairman of the program committee.

Metropolitan Hears Bishop

Metropolitan Chapter's March meeting featured a talk on *"Which Core Process"* presented by Warner B. Bishop, Archer-Daniels-Midland Co., Cleveland. Processes covered were conventional oil-sand with cereal or resin; shell or hollow cores; gas setting or CO_2 process; and air setting. Slides illustrated the effect of baking temperature and additional sequence on the strength of the finished core. Bishop stated that each process has its advantages and limitations and that each has its place in the foundry industry.

CHICKEN IN THE SHOP
or
How Silly Can You Get?

Said the little red rooster
to the little brown hen,
"I ain't had no adventure
since the Lord knows when.
So straighten up your feathers
and comb out your tail
long and tedious night
We're a-goin' through the foundry
if we have to go to jail."

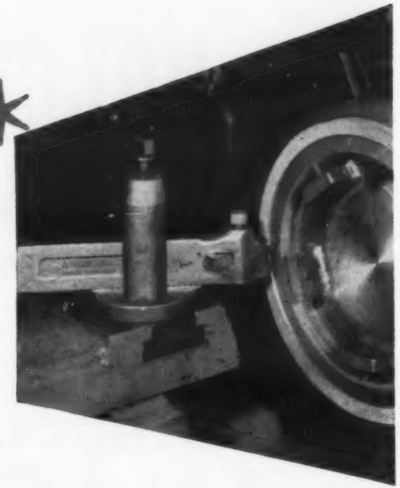
The molder was a-workin'
on his job to beat the band
He laid in the pattern
and he shoveled in the sand
He was startin' in to ram it
when his eyes began to pop
And he hollered to his helper,

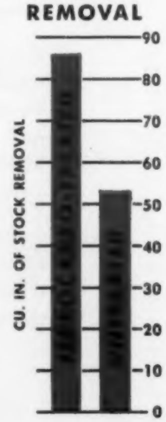
"There's a chicken in the shop!"
Up in the cleaning room
the grinding wheels was turnin'
And a riser cutter whispered
as he looked up from his burnin',
"People won't believe this
they'll say that we are liars
But unless my eyes deceive me
I see a couple fryers."

The fat old craneman saw them too,
and climbed down from his cab
Sneaked up behind our feathered
friends, and made a flying grab.
But the chickens they was quicker
and they scurried 'cross the floor
And their feathers all exploded
as they hurried out the door.

Squawked the little red rooster
"Gotta hurry like the dickens
The foundry's fascinatin'
but it ain't no place for chickens."
And the little brown hen cackled
as they hustled out the gate,
"I laid a hard boiled egg back there
on a twenty-thirty plate!"

▪ From *The Foundry Brad,* a column of foundry poems appearing in *The ESCO Ladle* of the Electric Steel Foundry Co., Portland, Ore. Bill Walkins, former sand mill operator, is both the editor of the *Ladle* and the one, and original Foundry Bard.





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Water-Cooled Cupolas Cut Production Costs at Ford

More metal at lower cost is being produced at Ford Motor Co. Dearborn foundry, by using external water-cooled cupolas. The operation of these cupolas was described by William H. Dawson of the Ford Motor Co. to members of the AFS Eastern Canada Chapter at their January meeting.

Ford has seven, 102-in. cupolas, lined in the well to 74 in. Six cupolas operate daily with a total capacity of 2500 tons.

The cupolas have no lining above the well. The height from the charging doors to the tuyeres is 26 ft. Just below the charging door is an expansion joint in the 1-in. vertical plate shell. The primary external water-cooling system starts here.

This system consists of a series of water jets supplied from a 6-in. main operating at 30 psi. Water from the spray runs down the outside of the shell and is collected in a weir. The forming of steam has been no problem. Four 6-in. water-cooled copper tuyeres project 10 in. beyond the lining.

Refractory is used only in the well. Carbon blocks were initially used but a pressed block of a clay-graphite mixture is now used.

Refractory consumption is about 12 per cent of that of a conventional cupola. The tap hole is lined with magnesite and carbon which normally erodes from 3 to 5 in. during operations. Very little erosion takes place in the tuyeres. Four men can patch and repair the cupola in an 8-hour day, putting it into condition for another 200 hours of melting.

The cupolas may be classified and operated as acid, basic, or neutral. Melting control has been found best when the operation is extreme acid or extreme basic. At the neutral stage, flux becomes critical. Due to the iron requirements at Ford, the operation is neutral or slightly acid. No flourspar is added and limestone is kept at a minimum. Metal temperatures at the spout are 2750 F for the first metal and 2710 F for the remainder of the melt.

If hot-blast were available, a finer control would compensate for variables such as stack height, blast pressure, down time and initial melting. To compensate for this, oxygen enrichment is used. Oxygen added is 2 per cent of the blast. Use of oxygen leads to a higher carbon content. For fuel Ford uses 6-in. high-quality coke.

The optimum time for dropping bottom has been found to be 200 hours.

Revised and Expanded Safety Practices Manual Tells How to Improve Foundries

■ RECOMMENDED SAFETY PRACTICES FOR THE PROTECTION OF WORKERS IN FOUNDRIES, just released, is a practical manual devoted exclusively to practices in the metal castings industry. It is a revision of the manual first published in 1940 and includes new sections on fire prevention, coremaking and molding, planning for safety, and a glossary.

The revision was made by the Safety Committee of the Safety, Hygiene and Air Pollution Control Program of the American Foundrymen's Society.

The committee prepared the manual to provide guides for making foundries safer places to work and to standardize safe practices in all foundries regardless of size.

Contained in the manual is information relating to design, construction and application of safeguards; personal protective devices for the prevention of injury; and to methods of promoting good housekeeping.

In the section on planning for safety, the responsibility of management and employees is outlined. Management, it points out, must treat safety as an important part of production and assume continuing administrative leadership in a sound safety program. Duties of employees include using machinery, equipment, tools, materials, personal protective equipment, and safeguards in an intelligent and safe manner.

In establishing a safety program the manual recommends that one person be responsible for its operation. This man should work closely with the work force and cooperate with the plant supervisory force in order to detect and eliminate unsafe conditions and practices.

Extensive coverage is given melting equipment, auxiliaries and ovens. Recommendations are made covering cupola charging, operations and repairing. Also discussed are open hearth furnaces, ladle pits, crucible furnaces, inoculations and oven equipment.

Recommendations are made on material handling and storage.

Cleaning and finishing operations and discussed including magnesium grinding, its equipment and safe practices.

Six sections detail safeguards for moving machinery, guarding prime movers, power transmission equipment, metal and woodworking machines and miscellaneous machinery.

Included in the section on personal protective devices are toe protection, leggings or spats, clothing, eye protection, respiratory equipment and ear and head equipment.

One of the most important chapters pertains to fire prevention. An analysis of 450 foundry fires reveals that common hazards account for 32 per cent of all fires and that special hazards are responsible for almost 60 per cent. Unknown causes make up slightly over 8 per cent. Typical fire extinguishers are illustrated and explained and one table is devoted to characteristics of approved portable extinguishers including normal capacities, composition of charge and effective discharge time.

Coremaking and molding precautions are discussed at length. Driers, sand mixing, core box cleaning, coreblowing machines and ovens are covered in the section on coremaking. Under molding, practices are recommended for sand systems, shakeouts, conveyors, carry-out operations, clamp and unclamp operations and molding machines.

Other sections are devoted to plant physical conditions; vats, boilers, unfired pressure vessels and pressure devices; installation and operation of electrical equipment.

The progressive mechanization of foundries has brought with it increased use of electric power, the manual points out in the section on electrical equipment. Because of the nature of certain foundry operations, it is imperative that the equipment be of such quality, design, and dependability that uninterrupted operations are assured.

The manual is composed of 24 sections and contains 54 pages. Extensive use is made of drawings and photographs to illustrate equipment and safe practices.

The manual points out that accident prevention not only reduces costs but improves employee public relations and increases operating efficiency. Furthermore, it states, every employer has a moral obligation to his employees to do all in his power to prevent injury to them, and thereby avoid the consequences of injury.

The recommendations are felt by the Safety Committee to constitute minimum standards. Where equivalent or superior protection is provided, such protection should be deemed to fulfill the purpose of the manual.

Members may purchase the book for $2.00, the non-member price is $4.00. Write to: Book Department, American Foundrymen's Society, Golf & Wolf Roads, Des Plaines, Ill.

MODERN CASTINGS Receives Safety Interest Award

Extensive coverage of safety problems in foundries has won for MODERN CASTINGS its second consecutive Public Interest Award from the National Safety Council. MODERN CASTINGS is again the only magazine in the metals working field to receive the award.

The non-competitive award is made annually to public information media for exceptional service to safety.

The 1956 award went to daily and weekly newspapers, radio and television stations and networks, magazines, advertisers, outdoor and transportation advertising companies.

"A review of these 1956 Public Interest Award entries shows beyond question the tremendous contribution of mass communication media to the safety movement," said Ned H. Dearborn, Council president. "We are proud to honor the outstanding leadership represented by these awards."

questions and answers

Misery loves company so why not share your castings problems with us? MODERN CASTINGS invites you to "stump the experts" with tales of gremlins that are haunting your scrap piles. If any of you readers have better answers to the questions below, write the editor.

man power

I would appreciate any information you might have regarding the man-hours per ton required for melting, coremaking, molding, trimming, and inspection in the average amuminum foundry producing 1 to 15 lb. castings of average complexity.

As the result of a special AFS study the following data was developed as a broad general guide:

Melting	– 6.6 to 12.3 man-hours per ton of metal poured.
Coremaking	–44.0 to 87.6 man-hours per ton of cores made.
Molding	–75.0 to 118.0 man-hours per ton of finished castings.
Trimming	–64.9 to 77.2 man-hours per ton of good castings produced.
Inspection	–24.6 to 34.4 man-hours per ton of finished castings.

torch-cutting stainless

Are there any ill-effects which might arise from breathing the fumes generated when cutting stainless steel with oxy-acetylene plus iron powder?

When torch-cutting stainless steel the workman will be exposed to extremely high concentrations of iron oxide and lesser amounts of chromium unless local exhaust ventilation is used. Accumulation of inert iron oxide in the lungs will appear as nodular shadows on an x-ray. This condition will appear in about two years and is known as non-disabling siderosis.

In regard to the chromium fumes, elemental chromium or chromic oxide (Cr_2O_3) have not been demonstrated to be toxic, although there is some evidence that the oxide can be irritating to the nose and throat. Both the element and the oxide can produce dermatitis in susceptible persons.

If the flame impinges on metal surfaces containing burned-in or adherent sand there is the added hazard of inhaling silica fumes. The degree and duration of this exposure determines the possibility of contracting silicosis.

cement-bonded sand

Having noted with interest your article on hardening cement-bonded sands with CO_2, described in the April issue of MODERN CASTINGS, I am interested in learning about some typical mixtures suitable for casting heavy iron and steel castings.

For heavy steel castings a suitable mix would contain 226 lb. of high-early-strength Portland-type cement per ton of silica sand (No. 50 AFS gfn) Moisture content should run between 5.5-7.5 per cent. An addition of 2 to 5 per cent seacoal to this mix makes it suitable for large gray iron castings. A core mix would contain about the same amount of cement but the sand should have a 70-90 AFS gfn. In hot spots where sand burn-in may be a problem, zircon sand should be used instead of silica sand. Since zircon is more dense than silica only 9 lb. of cement binder is needed per 100 lb. of sand. Molds for steel castings should be given a zircon wash to minimize metal penetration. A good formula for such a wash would contain 100 lb. zircon flour, 1 lb. dextrin, 1 lb. western bentonite, 2 oz. sodium bensoate, and 5 gal. water.

foundry facts

Casting Design / 11 Basic Rules

If the engineer of today is to take full advantage of the easy shaping of molten metal in the form of castings, he must know how to design his many components so they will have the requisite strength and functional properties required. He must have, in addition, a knowledge of the foundry problems involved in the making of castings to meet his design.

The form of the design, the method of making the pattern, the type of molding material, the nature, behavior, and characteristics of the metal in the mold, these all play an important part in determining whether the casting will be sound and provide the factor of safety intended. They also control the cost and time required for production.

Realizing that few design engineers are familiar with foundry practice, the Meehanite Metal Corporation has prepared a volume of instruction on engineering castings from which the following rules have been extracted.

Rule 1

Before issuing the final drawing, consult a competent foundryman or patternmaker.

Casting design poses two problems; one for the engineer, the other for the foundryman:

▪ The engineer must know how to design a casting so that it will actually have the requisite strength and functional properties.

▪ The foundryman must be able to make the casting so that it has the strength and functional properties the engineer intended it to have.

It is all too common to design to suit the engineering department but not the foundry, and the result may be failure or disappointment.

Rule 2

Construct a small model or visualize the casting in the mold.

Relatively few engineers or foundrymen can follow all section changes and shapes from a blueprint. Create a three-dimensional drawing or construct a small model. This procedure permits study of how the metal will enter the mold, how solidification proceeds, and shows what parts have to be fed to assure casting soundness.

A model to scale or full size in the form of a pattern that can be used later will help the designer see how cores must be designed and placed or omitted. Such a model will help the foundryman decide how to mold the casting, detect casting weakness, indicate where to place gates and risers, and answer other questions affecting casting soundness, cost, and delivery.

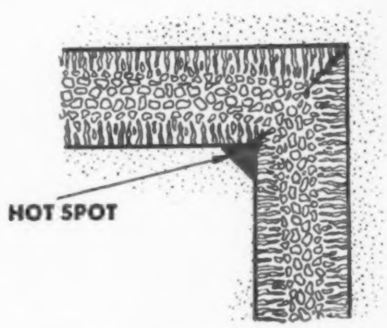
Rule 3

Design for casting soundness.

Most metals and alloys shrink when they solidify. Therefore, design so that all members of the parts increase in dimension progressively to one or more suitable locations where feeder heads can be placed to offset liquid shrinkage.

Rule 4

Always present a cooling surface. Avoid sharp angles and corners. Replace sharp angles and corners with radii.



Rule 4 . . Hot spots are the most common defect resulting from design.

Metal structure is affected by shape of casting section. Solidification of molten metal always proceeds from the mold face, forming unbalanced crystal grains that penetrate into the mass at right angles to the plane of cooling surface. A simple section presents uniform cooling and greatest freedom from mechanical weakness. When two or more sections conjoin, mechanical weakness is induced at the junction and free cooling is interrupted, creating a "hot spot."

In designing adjoining sections, avoid acute angles. Replace all sharp angles with radii and minimize heat and stress concentration.

Rule 5

Bring the minimum number of adjoining sections together. Stagger cross members.

Serious casting problems arise when an excessive number of members are joined. A well designed casting brings the minimum number of sections together and avoids acute angles. Staggered sections minimize the hot spot effect, eliminate structural weakness and reduce distortion. A cored hole at the junction of more than two sections will speed solidification, but a circular web with adjoining sections is preferred.

Rule 6

Design all sections as nearly uniform in thickness as possible.

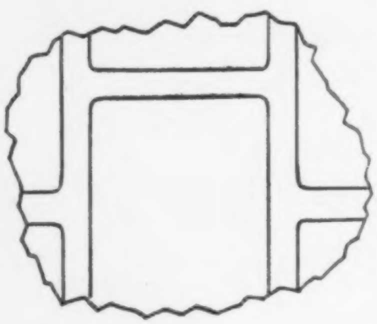
Design with sections of reasonable uniformity of thickness. Where this cannot be done, all heavy sections should be accessible for feeding.

Rule 7

Proportion dimension of inner walls.

Inner sections of castings, resulting

from complex cores, cool much slower than outer sections and cause variations in strength. A good rule is to reduce



Rule 5 . . Staggered sections reduce hot spot effect, eliminate weakness.

inner sections to 9/10 the thickness of the outer wall. Avoid rapid section changes and sharp angles. Whenever complex cores must be used, design for uniformity of section to avoid local heavy masses of metal.

Rule 8

Avoid abrupt section changes. Eliminate sharp corners at adjoining sections.

The difference in the relative thickness of adjoining sections should be kept to the minimum. The ratio of maximum to minimum thickness should not exceed 2:1. Where a greater difference cannot be avoided, consider design with detachable parts. When a change of thickness is less than 2:1, it may take the form of a fillet; where the difference is greater, the form recommended is a wedge. Wedge-shaped changes in wall thickness should be designed with a taper not exceeding 1 in 4.

Where light and heavy sections are unavoidable, use proper fillets or tapering sections, or both. If blending is not permissible, use fillets of fairly large size at junctions.

Rule 9

Fillet all sharp angles.

Fillets have three functional purposes:

- To reduce stress concentration in the casting in service.
- To eliminate cracks, tears, and draws at re-entry angles.
- To make corners more moldable and to eliminate hot spots.

The number of radii in fillets in one pattern should be the minimum possible, preferably only one. To meet engineering stress requirements and to reduce stress concentration, relatively large fillets are used with the radius equal to or exceeding the casting section.

In the case of V or Y sections and other angular forms, always design so as to allow a generous radius to avoid localization of heat.

Rule 10

Design ribs and brackets for maximum effectiveness.

Ribs have two functions:

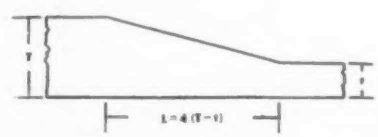
- To increase stiffness.
- To reduce weight.

If ribs are too shallow in depth, or too widely spaced, they will be ineffectual. Correct rib depth and spacing is a matter of engineering design. Design preference in average design is for ribs to have a greater depth than thickness.

Thickness of ribs should equal 80 per cent of casting thickness. Ribs should be rounded at the edge and must be correctly filleted.

Ribs in compression offer a greater factor of safety than ribs in tension. However, castings with thin ribs or webs in compression may require design changes to provide necessary stiffening to prevent buckling.

Avoid complex ribbing. It simplifies molding procedure, assures more uniform solidification conditions and eliminates hot spots. Casting stresses and stress distribution favor omission of ribbing if the casting wall can be made of ample strength and stiffness.



Rule 8 . . When change in thickness is greater than 2:1, use wedge shape.

Ribs meeting at acute angles cause molding difficulties, increase costs and aggravate the risk of defective castings.

Rule 11

Avoid use of bosses, lugs, and pads.

Bosses and pads increase metal thickness, create hot spots and cause open grain or draws. Blend bosses and pads into the casting by tapering or flattening the fillets. Bosses should not be included in casting design when the surface may be obtained by milling or countersinking.

A continuous rib can be used instead of a series of bosses.

Thickness of bosses and pads should preferably be less than the thickness of the casting section they adjoin, but thick enough to permit machining without touching the casting wall. Where the casting section is light and does not permit use of this rule, the following minimum recommended heights can serve as a guide.

Approximate Casting Length (ft)	Height of Boss (in.)
Up to 1½	0.25
1½ to 6	0.75
Over 6	1.0

When there are several lugs and bosses on one surface, they should be joined to facilitate machining. Panels of uniform thickness instead of many pads will simplify machining.

■ Adapted from *Casting Design as Influenced by Foundry Practice*, Mechanite Metal Corporation, New Rochelle, N. Y.

afs chapter meetings

MAY

Birmingham District . . **May 17** . . Tutwiler Hotel, Birmingham, Ala. . . *Panel, Local Core Practices.* E. C. Finch, Moderator, American Cast Iron Pipe Co.; A. Glidewell, Jackson Industries, Inc., *"Small Gray Iron Cores;"* J. G. Lovell, Stockham Valves & Fittings, *"Malleable and Brass Cores;"* R. Bedford, American Cast Iron Pipe Co., *"Large Gray Iron and Steel Cores."*

British Columbia . . **May 15** . . Pacific Athletic Club, Vancouver, B. C. . . *Election of Officers.*

Canton District . . *No Meeting.**

Central Illinois . . *No Meeting.**

Central Indiana . . **May 13** . . Athenaeum Turners, Indianapolis . . C. E. Drury, Central Foundry Div., GMC, *"Gating to Control Pouring and Its Effect on Castings."*

Central Michigan . . **May 15** . . Hart Hotel, Battle Creek, Mich. . . *Management Night.*

Central New York . . *No Meeting.**

Central Ohio . . **May 13** . . Seneca Hotel, Columbus, Ohio . . D. C. Williams, Ohio State University, *"pH—Pardon, But Your Ions Are Showing."*

Chesapeake . . **May 24** . . Chambersburg, Pa. . . *Annual Spring Outing and Visitation to Chambersburg Engineering Co. and T. B. Wood's Sons Co.*

Chesapeake, Southern Section . . *No Meeting.**

Chicago . . *No Meeting.**

Cincinnati District . . *No information available.*

Connecticut . . **May 28** . . Hartford, Conn. . . O. J. Myers, Reichold Chemicals, Inc., *"Sand."*

Corn Belt . . **May 10** . . Steeple House, Beatrice, Neb. . . H. W. Northrup, International Nickel Co., *"Ductile Iron."*

Detroit . . *No Meeting.**

Eastern Canada . . **May 10** . . Sheraton-Mount Royal Hotel, Montreal, Que. . . *Annual Business Meeting, Elections.*

Eastern New York . . **May 21** . . Panetta's Restaurant, Menands, N. Y. . . *Joint Meeting with Society of Safety Engineers. Panel Discussion on Safety.*

Metropolitan . . **May 13** . . Essex House, Newark, N. J. . . C. F. Walton, Gray Iron Founders' Society, *"Heading and Gating of Gray Iron."*

Mexico City . . *No information available.*

Michiana . . *No Meeting.**

Mid-South . . **May 10** . . Hotel Clarridge, Memphis, Tenn. . . *Election of Officers and Round Table Discussion.*

Mo-Kan . . **May 3** . . Fairfax Airport, Kansas City, Kans. . . F. Scaggs, Oklahoma Steel Castings Co., *"Practical Utilization of CO_2 Cores."*

New England . . **May 8** . . University Club, Boston . . H. W. Schwengel, Modern Equipment Co., *"New Developments in Equipment for Melting."*

Northeastern Ohio . . **May 16** . . Tudor Arms Hotel, Cleveland . . *Old Timers' Night.*

Northern California . . *No information available.*

Northern Illinois-Southern Wisconsin . . **May 14** . . Lafayette Hotel, Rockford, Ill. . . Z. Madacey, Beardsley & Piper Div., Pettibone Mulliken Corp., *"Coremaking and Core Blowing."*

Northwestern Pennsylvania . . **May 27** . . Amity Inn, Erie, Pa. . . *AFS Film, "Effect of Gating Design on Casting Quality."*

Ontario . . **May 17** . . Royal York Hotel, Toronto, Ont. . . Film, American Brass & Iron Foundry, *"Production of Copper Ores & Copper."*

Oregon . . **May 15** . . Heathman Hotel, Portland, Ore. . . *Tour through Oregon Steel Rolling Mills, Portland, Ore.*

Philadelphia . . **May 10** . . Engineers' Club, Philadelphia . . *"Air Pollution & Ventilation Problems in the Foundry."*

Pittsburgh . . **May 20** . . Webster Hall Hotel, Pittsburgh, Pa. . . *Education Program.*

Quad City . . **May 20** . . Hotel Ft. Armstrong, Rock Island, Ill. . . *Panel Discussions—Cores:* (1) *Ingredients, Mixing and Making;* (2) *Baking, Assembly, Washes, etc.*

Rochester . . **May 14** . . Seneca Hotel, Rochester, N. Y. . . *Election of Officers.*

Saginaw Valley . . **May 2** . . Fischer's Hotel, Frankenmuth, Mich. . . N. J. Ellis, GMC, *"In-Plant Labor Relations."*

St. Louis . . **May 16** . . Edmond's Restaurant, St Louis . . L. B. Knight, Lester B. Knight & Associates, Inc., *"Mechanization." Rolla Students' Night.*

Southern California . . **May 10** . . Rodger Young Auditorium, Los Angeles . . W. C. Baud, Mechanical Foundries Div., Food Machinery & Chemical Corp., *"The Foundry's Greatest Problem."*

Tennessee . . **May 24** . . Patten Hotel, Chattanooga, Tenn.

Texas . . **May 18** . . Ridglea Country Club, Ft. Worth, Texas . . W. A. Wiksell, Louisiana State Univ., *"Have You Tried Listening?"*

Timberline . . *No information available.*

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* Many Chapters have cancelled May meetings to avoid conflict with 1st Engineered Castings Show and 61st Castings Congress.

Toledo . . *No information available.*

Tri-State . . May 17 . . Blackwell, Okla. . . R. A. Clark, Electro Metallurgical Co., *"Layman's Gray Iron Metallurgy."*

Twin City . . May 14 . . The Covered Wagon, Minneapolis . . C. W. Gilchrist, Cooper-Bessemer Corp., *"Riserless Castings."*

Utah . . *No information available.*

Washington . . May 16 . . Engineers' Club, Seattle . . *Sand Panel, Four Speakers and Round Table Discussion.*

Western Michigan . . May 6 . . Bill Stern's, Muskegon Heights, Mich. . . A. A. Adams, Ford Motor Co., *"Shell Molding & Shell Cores."*

Western New York . . May 14 . . Sheraton Hotel, Buffalo, N. Y. . . E. F. Hayes, Hanna Furnace Corp., *"Our Economic System."*

Wisconsin . . May 3 . . Schroeder Hotel, Milwaukee . . *Annual Apprenticeship and Old Timers' Meeting.*

JUNE

Central Illinois . . June 8 . . 497th Engineers' Cabin, Groveland, Ill. . . *Annual Stag, Clam Bake and Barbecue.*

Central Michigan . . June 8 . . *Annual Outing.*

Chesapeake, Southern Section . . June 7 . . Virginian Hotel, Lynchburg, Va. . . K. G. Presser, Forest City Foundries Co., *"Gating and Risering."*

Northern Illinois-Southern Wisconsin . . June 11 . . Beloit Country Club, Beloit, Wis. . . *Annual Picnic.*

Oregon . . June 19 . . Heathman Hotel, Portland, Ore . . *Casting Clinic and Business Meeting.*

Saginaw Valley . . June 1 . . *Annual Outing.*

Southern California . . June 14 . . Rodger Young Auditorium, Los Angeles . . *Past Presidents' Night.*

Western New York . . June 14 . . *Annual Picnic.*

A.S.T.M. Drops Alloys

Deletion of two aluminum base alloys, SC54A and SC54B, zinc base alloy AC43A and magnesium alloy AM100B, from the American Society for Testing Materials covering die castings has been approved by the A.S.T.M. committee on die cast metals and alloys. The aluminum alloys were dropped since they have been replaced by better alloys. Alloys AC43A and AM100B were dropped since they were not as stable as other alloys.

obituaries

William LaCoste Neilson, vice president and former director of Norton Co., Worcester, Mass. died March 5. Associated with Norton Co. for fifty years he managed the company's plants in various parts of the world. He was also a consultant for the U. S. Treasury Department and Department of Agriculture.

William A. Kennedy, supervisor of products, Grinnell Corp., Providence, R.I., died April 9. He had been a member of AFS Malleable Division committees for thirteen years.

Detail and Liason Work Reduce Casting Costs

■ Application of more detail in marking pattern blueprints and close liason with foundry engineering departments has resulted in lowering pattern and casting purchase costs for Giddings & Lewis Tool Co., Fond du Lac, Wis., machine tool manufacturer.

Operations of the Giddings & Lewis program were outlined by W. T. Schmidt, supervisor of patterns and castings and head of the pattern department, at the December meeting of the AFS Chicago Chapter.

Giddings & Lewis formerly maintained a patternmaking shop but now conducts a four-man patternbuying department as a division of the purchasing department. In 1955 more than $207,000 spent on patterns from nine sources.

The plan for purchasing patterns involves use of a tracing showing the pattern in detail as well as all cores. The core prints are shown to scale wherever possible. Some loose pieces are shown wherever necessary to make the pattern and core box complete.

After the tracing has been marked, copies are made for shops desiring to bid on the job. An extra print is marked and sent to the foundry that is to produce the casting.

Pattern shops desiring to bid on the job are sent a copy of the drawing and quotation requests describing the equipment in detail, thickness of material and how the headers are to be built and spaced.

Thus all pattern shops are quoting on identical equipment. A copy of the quotation request is also sent to the foundry.

CIRCLE NO. 198, PAGE 7-8

Classified Advertising

For Sale, Help Wanted, Personals, Engineering Service, etc., set solid . . 25c per word, 30 words ($7.50) minimum, prepaid.

Positions Wanted . . 10c per word, 30 words ($3.00) minimum, prepaid. Box number, care of **Modern Castings**, counts as 10 additional words.

Display Classified . . Based on per-column width, per inch . . 1-time, **$18.00**; 6-time, **$16.50 per insertion**; 12-time, **$15.00 per insertion; prepaid.**

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PATTERN DRAFTSMEN

Experienced in the design of pattern equipment, core boxes, qualifying fixtures, and gauges.

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Write stating qualifications or phone:

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General Motors Corporation
Defiance, Ohio
Phone: Defiance 2-2915

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Must Be Fully Qualified To
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WE LIVE in scenic southern New Hampshire, close to the White Mts. 60 mins. to Boston.

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PLUS . . . profit sharing, broad fringe benefits, ideal work conditions.

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. . . . **HOW ABOUT YOU?**

WRITE—HITCHINER MFG. CO.
MILFORD 3, NEW HAMPSHIRE

FOREMAN to take complete charge of molding and coremaking operations in a small new gray iron foundry. Must be familiar with pattern and corebox rigging. Excellent opportunity for aggressive young man. Located in Cincinnati area. Send complete resume and salary requirements to **Box D42, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

INDUSTRIAL ENGINEERS
OR
MECHANICAL ENGINEERS

For positions in the **METHODS ENGINEERING DEPARTMENT** of a large, gray iron foundry located in Northwest Ohio. Engineering degree or its equivalent required. Experience preferred but not essential.

Excellent Salary
Outstanding Opportunity
Permanent Position
Write stating qualifications or phone:

Personnel Department
Defiance Plant — Central Foundry Division
General Motors Corporation
Defiance, Ohio
Phone: Defiance 2-2915

FOUNDRY FOREMAN to take charge of molding floor for medium sized stainless foundry. Must know gating, risering, sand control and management of men. **Box D43, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

SUPERINTENDENT for progressive medium-sized gray iron foundry in Texas that makes a wide variety of work including both production and jobbing work. Must be capable of handling production on jolt squeeze and roll-over molding machines and floor molding. Foundry of 50 years experience. Send references and past experience. **Box D48, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

FOUNDRY FOREMAN to handle the production on rollover molding machines and large floors in gray iron foundry in Southwest. Please give references and complete experience in first letter. **Box D47, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

Positions Wanted

SUPERINTENDENT or INDUSTRIAL ENGINEER. BS in chemical engineering, 1938. Nineteen years experience in mechanized brass, nickel alloys, and aluminum foundries. Know blended sand control, metallurgical melting, and scrap control. Five years experience in industrial engineering in semi-jobbing and production foundries. **Box D40, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

DIRECTOR OF METALLURGICAL LABORATORY, Ph. D., 34, 10 years in casting control, research and development. Experience in setting up and carrying out an effective research program. Prefer West Coast. **Box D45, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

ENGINEER—SALES, MANAGEMENT. Mechanical engineer, early thirties. Varied experience in production problems, plant & design engineering; gray iron & steel. Energetic and persevering. Presently employed in an executive position. Prefer Midwest location. **Address Box D46, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

For Sale

MOLDING MACHINE: Herman 6000# capacity, jolt-roll-draw in operating condition. asking $2,900.00 FOB **Pottstown Machine Co., Pottstown, Pa. (Phone 37, H. H. Houston)**

FURNACES FOR SALE

10 used Heat Treating Furnaces, and two 7-ton gantry cranes, good condition, priced to sell.

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advertisers and their agencies

Continued on Page 140

casting through the ages

This index is published as a convenience to the readers. While every care is taken to make it accurate MODERN CASTINGS assumes no responsibility for errors or omissions.

Issue Brazing Filler Data

Revised specifications for brazing filler metal have been issued jointly by the American Welding Society and the American Society for Testing Materials. Twenty-nine classifications are included and grouped into seven types according to principal constituents. These are: aluminum-silicon, copper-phosphorus, silver, copper-gold, copper and copper-zinc, magnesium, and heat-resisting materials.

Details are provided on chemical composition of the filler metals, standard sizes and lengths, packaging, and marking. Copies may be obtained from either of the participating societies.

CIRCLE NO. 202, PAGE 7-8